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Reviews.

I.—North American Archæology. By John Lubbock, F.R.S., L.S., and G.S.

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2. Aboriginal Monuments of the State of New York, comprising the Results of Original Surveys and Explorations; with an illustrative Appendix. By E. G. Squier, A.M.
3. The Antiquities of Wisconsin, as surveyed and described by J. A. Lapham.
4. The Archæology of the United States; or Sketches, Historical and Bibliographical, of the Progress of Information and Opinion respecting Vestiges of Antiquity in the United States. By Samuel F. Haven.
5. Prehistoric Man: Researches into the Origin of Civilisation in the Old and the New World. By Daniel Wilson, LL.D.

The first four works which we have placed at the head of this article form a part of the long series of scientific researches, which have been published, under the auspices of the Smithsonian Institution. There are several other memoirs which we ought perhaps to have added to our list, and especially one by Mr. Caleb Atwater, who, according to Messrs. Squier and Davis, " deserves the credit of being the pioneer in this department." His researches form the first volume of the Archæologia Americana, which was published in 1819, and contains plans and descriptions of many ancient works.

The memoir by Messrs. Squier and Davis, occupying more than three hundred pages, is chiefly descriptive of ancient fortifications, enclosures, temples and mounds, and of the different implements, ornaments, &c. which have been obtained from them. It is embellished with forty-eight plates, and no less than two hundred and seven woodcuts.

In his second work, Mr. Squier confines himself to the antiquities of the State of New York. Within these limits, however, he describes many ancient monuments of various kinds, and he feels "warranted in estimating the number which originally existed in "the State at from two hundred to two hundred and fifty." He comes to the conclusion, "little anticipated," he says, "when I started "upon my trip of exploration, that the earthworks of Western New "York were erected by the Iroquois, or their western neighbours, "and do not possess an antiquity going very far back of the discovery." (*sic.*)

The systematic exploration of the ancient remains in Wisconsin, of which the memoir by Mr. Lapham is the result, was undertaken by him on behalf of the American Antiquarian Society, from whose funds the necessary expenses were provided. The cost of the publishing, however, which from the great number of engravings (fifty-five plates, besides sixty-one wood engravings) was considerable, was defrayed by the Smithsonian Institution, and the work is included in the Seventh Volume of "Contributions." As our account of the "Animal Mounds" will be almost entirely derived from the data furnished by Mr. Lapham, we will for the moment say no more on the subject.

Mr. Haven's work is well described in the title, and forms an interesting introduction to the study of North American Archæology. He gives us comparatively few observations or opinions of his own; but after a careful examination of what others have written, he comes to the conclusion that the ancient earthworks of the United States "differ less in kind than in degree from other remains concerning "which history has not been entirely silent. They are more nume"rous, more concentrated, and in some particulars on a larger scale "of labour, than the works which approach them on their several "borders, and with whose various characters they are blended. Their "numbers may be the result of frequent changes of residence by a "comparatively limited population, in accordance with a supersti"tious trait of the Indian nature, leading to the abandonment of "places where any great calamity has been suffered; but they appear "rather to indicate a country thickly inhabited for a period long "enough to admit of the progressive enlargement and extension of "its movements."

The last work on our list is of a very different nature. It is more general and more ambitious. At the same time, it scarcely fulfils the promise of its title; for though some portions are sufficiently general, by far the larger part is purely North American. It will form the subject of a separate notice in this Review.

The antiquities themselves fall into two great divisions: Implements (including ornaments) and Earthworks. The Earthworks have been divided by the American Archæologists into seven classes:

1. Defensive enclosures; 2. Sacred and Miscellaneous enclosures; 3. Sepulchral mounds; 4. Sacrificial mounds; 5. Temple mounds; 6. "Animal" mounds; and 7. Miscellaneous mounds. These classes we shall treat separately, and we can then better consider the "mound-builders" themselves.

Implements.

The simple weapons of bone and stone which are found in America closely resemble those which occur in other countries. The flakes, hatchets, axes, arrow-heads, and bone implements are, for instance, very similar to those which occur in the Swiss lakes, if only we make allowance for the differences of material. In addition to the simple forms, which may almost be said to be ubiquitous, there are some, however, which are more complicated. In many cases they are perforated, as for instance those figured by Messrs. Squier and Davis (l. c. p. 218). These perforated axes are generally considered in Europe to belong to the metallic age, as also was probably the case in the New World.

At the time of the discovery of America, iron was absolutely unknown to the natives, with the exception perhaps of a tribe near the mouth of the La Plata, who had arrows tipped with this metal, which they are supposed to have obtained from masses of native iron. The powerful nations of Central America were, however, in the age of Bronze, while the North Americans were in a condition of which we find in Europe but scanty traces—namely, in the age of Copper. Silver is the only other metal which has been found in the ancient tumuli, and that but in very small quantities. It occurs sparingly in a native form with the copper of Lake Superior, whence, in all probability, it was derived. It does not appear to have been ever smelted. From the large quantity of galena which is found in the mounds, Messrs. Squier and Davis are disposed to think that lead must have been used to a certain extent by the North American tribes: the metal itself, however, has not, I believe, yet been found.

Copper, on the other hand, occurs frequently in the tumuli, both wrought and unwrought. The axes have a striking resemblance to the simple axes of Europe, which contain the minimum quantity of tin; and some of the Mexican paintings give us interesting evidence as to the manner in which they were handled and used. These, however, were of bronze, and had therefore been fused; but the Indian axes, which are of pure copper, appear in all cases to have been worked in a cold state, which is the more remarkable, because, as Messrs. Squier and Davis have well observed, "the fires upon the "altar were sufficiently intense to melt down the copper implements "and ornaments deposited upon them. The hint thus afforded does "not seem to have been seized upon." *

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* One "cast" copper axe is however recorded as having been found in the State of New York, but there is no evidence to show by whom it was made.

This is less surprising than it at first appears, if we remember that round Lake Superior, and in some other still more northern localities, copper is found native in large quantities, and the Indians had therefore nothing to do but to break off pieces and hammer them into the required shape. Hearne's celebrated Journey to the mouth of the Coppermine River was undertaken in order to examine the locality whence the natives of that district obtained the metal. In this case it occurred in lumps actually on the surface, and the Indians seem to have picked up what they could, without attempting anything that could be called mining. Round Lake Superior, however, the case is very different. A short account of the ancient coppermines is given by Messrs. Squier and Davis in the work already so often cited, by Mr. Squier in "The Aboriginal Monuments of the State of New York," and by Mr. Lapham,* while the same subject is treated at considerable length by Prof. Wilson. The works appear to have been first discovered in 1847 by the agent of the Minnesota Mining Company.

"Following up the indications of a continuous depression in the " soil, he came at length to a cavern where he found several porcupines " had fixed their quarters for hybernation; but detecting evidences " of artificial excavation, he proceeded to clear out the accumulated " soil, and not only exposed to view a vein of copper, but found in the " rubbish numerous stone mauls and hammers of the ancient work- " men. Subsequent observations brought to light ancient excavations " of great extent, frequently from twenty-five to thirty feet deep, and " scattered over an area of several miles. The rubbish taken from " these is piled up in mounds alongside; while the trenches have " been gradually refilled with the soil and decaying vegetable-matter " gathered through the long centuries since their desertion; and over " all, the giants of the forest have grown, and withered, and fallen to " decay. Mr. Knapp, the agent of the Minnesota Mining Company, " counted 395 annular rings on a hemlock-tree, which grew on one " of the mounds of earth thrown out of an ancient mine. Mr. Foster " also notes the great size and age of a pine stump, which must have " grown, flourished and died since the works were deserted; and " Mr. C. Whittlesley not only refers to living trees now flourishing " in the gathered soil of the abandoned trenches, upwards of three " hundred years old, but he adds, 'On the same spot there are the " decayed trunks of a preceding generation or generations of trees " that have arrived at maturity, and fallen down from old age.' " According to the same writer, in a communication made to the " American Association, at the Montreal meeting in 1857, these " ancient works extend over a track from 100 to 150 miles in length, " along the southern shore of the lake."

In another excavation was found a detached mass of native copper, weighing upwards of six tons. It rested on an artificial cradle of black oak, partly preserved by immersion in water. Various implements and tools of the same metal were found with it. The commonest of these are the stone mauls or hammers, of which from one place ten cart-loads were obtained. With these were "Stone axes of "large size, made of greenstone, and shaped to receive withe-handles." "Some large round greenstone masses, that had apparently been used "for sledges, were also found. They had round holes bored in them "to a depth of several inches, which seemed to have been designed "for wooden plugs, to which withe-handles might be attached, so that "several men could swing them with sufficient force to break the "rock and the projecting masses of copper. Some of them were "broken, and some of the projecting ends of rock exhibited marks "of having been battered in the manner here suggested." *

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* Loc. cit. p. 74.

Wooden implements are so perishable that we could not expect many of them to have been found. Two or three wooden bowls, a trough, and some shovels with long handles, are all that appear to be recorded.

It has often been stated that the Indians possessed some method, at present unknown, by which they were enabled to harden the copper. This, however, from examinations instituted by Prof. Wilson, seems to be an error. Some copper implements, which he submitted to Prof. Crofts, were found to be no harder than the native copper from Lake Superior. "The structure of the metal was also highly laminated, as if the instrument had been brought to its present shape "by hammering out a solid mass of copper."

Pottery.

Before the introduction of metallic vessels, the art of the potter was much more important even than it is at present. Accordingly, the sites of all ancient habitations are marked by numerous fragments of pottery lying about: this is as true of the ancient Indian settlements, as of the Celtic towns of England, or the Lake villages of Switzerland. These fragments, however, would generally be those of rude household vessels, and it is principally from the tumuli that we obtain those better-made urns and cups from which the state of the art may fairly be inferred. Yet I know of no British sepulchral urn, belonging to the Stone age, which has upon it a curved line. It is unnecessary to add that representations of animals or plants are entirely wanting. They are also absent from all articles belonging to the Bronze age in Switzerland, and I might almost say in Western Europe generally, while ornaments of curved and spiral lines are eminently characteristic of this period. The ornamental ideas of the Stone age, on the other hand, are confined, so far as we know, to compositions of straight lines, and the idea of a curve does not seem to have occurred to them. The most elegant ornaments on their vases

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* Prof. W. W. Mather, in a letter to Mr. Squier, l. c. p. 184.

are impressions of the finger-nail, or of a cord wound round the soft clay.

Very different was the condition of American Art. Dr. Wilson has well pointed out, that, as regards Europe, "in no single case is "any attempt made to imitate leaf or flower, bird, beast, or any "simple natural object; and when, in the bronze work of the later "Iron period, imitative forms at length appear, they are chiefly the "snake and dragon shapes and patterns, borrowed seemingly by Celtic "and Teutonic wanderers, with the wild fancies of their mythology, "from the far Eastern cradle-land of their birth." This rule, however general, is not quite without exceptions; witness the bronze knife, fig. 166, in the Catalogue of the Copenhagen Museum. This interesting specimen has for a handle the figure of a man, which, however, is but a poor specimen of art. Moreover, some doubt may possibly be entertained about the age of this knife: the tip is broken off, but the blade, as far as it goes, is quite straight in the back,—a form which, though general in the Iron age, is seldom, if ever, found in knives of the Bronze age, in which the back part is always more or less curved.*

But I must not suffer myself to be led into a digression on Ancient Art, especially as M. Morlot has been specially devoting himself to this study, and, in his forthcoming work on the Antiquities of Mecklenbourg, will, I hope, throw much light on the subject.

"Among the North American mound-builders the art of pottery "attained to a considerable degree of perfection." Some vases, indeed, are said to rival, "in elegance of model, delicacy and finish," the best Peruvian specimens. The material used is a fine clay: in the more delicate specimens, pure; in the coarser ones, mixed with pounded quartz. The art of glazing and the use of the potter's wheel appear not to have been known, though that "simple approximation to a potter's wheel may have existed," which consists of "a stick of wood "grasped in the hand by the middle, and turned round inside a wall "of clay formed by the other hand or by another workman." †

Among the most characteristic specimens of ancient American pottery are the Pipes. Some of these are simple bowls, smaller indeed, but otherwise not unlike a common everyday pipe, from which they differ however in having generally no stem, the mouth having apparently been applied direct to the bowl. Others are highly ornamented, and many are spirited representations of monsters or of animals, such as the beaver, otter, wild cat, elk, bear, wolf, panther, raccoon, opossum, squirrel, manatee, eagle, hawk, heron, owl, buzzard, raven, swallow, parroquet, duck, grouse, and many others. The most interesting of these, perhaps, is the Manatee or Lamantin, of which seven representations have been found in the mounds of Ohio. These are no mere rude sculptures, about which there might easily be a mistake, but "the truncated head, thick semicircular snout, peculiar nostrils, "tumid, furrowed upper lip, singular feet or fins, and remarkable "moustaches, are all distinctly marked, and render the recognition "of the animal complete." * This curious animal is not at present found farther north than the shores of Florida, a thousand miles away.

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* I except, of course, the small razor-knives, which (Copenhagen Catalogue, Nos. 171 to 175) have a totally different form. These, moreover, from the character of their ornamentation, belong probably to the close of the Bronze age, if not to that of Iron.

† Squier and Davis, l. c. p. 195.

ORNAMENTS.

The ornaments which have been found in the mounds consist of beads, shells, necklaces, pendants, plates of mica, bracelets, gorgets, &c. The number of beads is sometimes quite surprising. Thus the celebrated Grave Creek mound contained between three and four thousand shell-beads, besides about two hundred and fifty ornaments of mica, several bracelets of copper, and various articles carved in stone. The beads are generally made of shell, but are sometimes cut out of bone or teeth; in form they are generally round or oblong; sometimes the shell of the Unio is cut and strung so as to "exhibit the convex surface and pearly nacre of the shell." The necklaces are often made of beads or shells, but sometimes of teeth. The ornaments of mica are thin plates of various forms, each of which has a small hole. The bracelets are of copper, and generally encircle the arms of the skeletons, besides being frequent on the "altars." They are simple rings, "hammered out with more or less skill, and so bent "that the ends approach, or lap over, each other." The so-called "gorgets" are thin plates of copper, always with two holes, and probably therefore worn as badges of authority.

EARTHWORKS.

Defensive Enclosures.

The works belonging to the first class "usually occupy strong "natural positions," and as a fair specimen of them we may take the Bourneville Enclosure in Ross County, Ohio. "This work," say Messrs. Squier and Davis (l. c. p. 11), "occupies the summit of a "lofty detached hill, twelve miles westward from the city of Chillicothe, near the village of Bourneville. The hill is not far from "four hundred feet in perpendicular height; and is remarkable, even "among the steep hills of the west, for the general abruptness of its "sides, which at some points are absolutely inaccessible." . . . . . . "The defences consist of a wall of stone, which is carried round the "hill a little below the brow; but at some places it rises, so as to cut "off the narrow spurs, and extends across the neck that connects "the hill with the range beyond." It must not, however, be understood that anything like a true wall now exists; the present appearance is rather what might have been "expected from the falling "outwards of a wall of stones, placed, as this was, upon the declivity "of a hill." Where it is most distinct it is from fifteen to twenty feet wide, by three or four in height. The area thus enclosed is about one hundred and forty acres, and the wall is two miles and a quarter in length. The stones themselves vary much in size, and Messrs. Squier and Davis suggest that the wall may originally have been about eight feet high, with an equal base. At present, trees of the largest size are growing upon it. On a similar work, known as "Fort Hill," Highland County, Ohio, Messrs. Squier and Davis found a splendid chestnut tree, which they suppose to have been six hundred years old. "If," they say, "to this we add the probable "period intervening from the time of the building of this work to its "abandonment, and the subsequent period up to its invasion by the "forest, we are led irresistibly to the conclusion that it has an anti-"quity of at least one thousand years. But when we notice, all "around us, the crumbling trunks of trees, half hidden in the accu-"mulating soil, we are induced to fix on an antiquity still more "remote."

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* Squier and Davis, l. c. p. 252.

The enclosure known as Clark's Work, in Ross County, Ohio, is one of the largest and most interesting. It consists of a parallelogram, two thousand eight hundred feet by eighteen hundred, and enclosing about one hundred and eleven acres. To the right of this, the principal work is a *perfect square*, containing an area of about sixteen acres. Each side is eight hundred and fifty feet in length, and in the middle of each is a gateway thirty feet wide, and covered by a small mound. Within the area of the great work are several smaller mounds and enclosures; and it is estimated that not less than three millions of cubic feet of earth were used in this great undertaking.

It has also been observed that water is almost invariably found within, or close to these enclosures.

Sacred and Miscellaneous Enclosures.

If the purpose for which the works belonging to the first class were erected is very evident, the same cannot be said for those which we have now to mention. That they were not intended for defence is inferred by Messrs. Squier and Davis from their small size, from the ditch being inside the embankment, and from their position, which is often completely commanded by neighbouring heights.

Dr. Wilson also (Vol. i. p. 324) follows Sir R. C. Hoare in considering the position of the ditch as being a distinguishing mark between military and religious works. But Catlin expressly tells us that in the Mandan village which he describes, the ditch was on the inner side of the embankment, and the warriors were thus sheltered while they shot their arrows through the stockade. We see, therefore, that, in America at least, this is no reliable guide.

While, however, the defensive earthworks occupy hill tops, and other situations most easy to defend, the so-called sacred enclosures are generally found on "the broad and level river bottoms, seldom "occurring upon the table-lands, or where the surface of the ground "is undulating or broken." They are usually square or circular in form; a circle being often combined with one or two squares. "Occasionally we find them isolated, but more frequently in groups. "The greater number of the circles are of small size, with a nearly "uniform diameter of two hundred and fifty or three hundred feet, "and invariably have the ditch interior to the wall." Some of the circles, however, are much larger, enclosing fifty acres or more. The squares or other rectangular works never have a ditch, and the earth of which they are composed appears to have been taken up evenly from the surface, or from large pits in the neighbourhood. They vary much in size; five or six of them, however, are "exact squares, "each side measuring one thousand and eighty feet—a coincidence "which could not possibly be accidental, and which must possess "some significance." The circles also, in spite of their great size, are perfectly round, so that the American Archæologists consider themselves justified in concluding that the mound-builders must have had some standard of measurement, and some means of determining angles.

The most remarkable group is that near Newark, in the Scioto Valley, which covers an area of *four square miles!* A plan of these gigantic works is given by Messrs. Squier and Davis, and another, from a later survey, by Mr. Wilson. They consist of an octagon, with an area of fifty, a square occupying twenty acres, two large circles occupying respectively thirty and twenty acres. From the octagon an avenue formed by parallel walls extends southwards for two miles and a half; there are two other avenues which are rather more than a mile in length, one of them connecting the octagon with the square.

Besides these, there are various other embankments and small circles, the greater number about eighty feet in diameter, but some few much larger. The walls of these small circles, as well as those of the avenues and of the irregular portions of the works generally, are very slight, and for the most part about four feet in height. The other embankments are much more considerable; the walls of the large circle are even now twelve feet high with a base of fifty feet, and an interior ditch seven feet deep and thirty-five in width. At the gateway, however, they are still more imposing; the walls being sixteen feet high, and the ditch thirteen feet deep. The whole area is covered with "gigantic trees of a primitive forest;" and, say Messrs. Squier and Davis, "in entering the ancient avenue for the "first time, the visitor does not fail to experience a sensation of awe, "such as he might feel in passing the portals of an Egyptian temple, "or in gazing upon the silent ruins of Petra of the desert."

The city of Circleville takes its name from one of these embankments, which, however, is no more remarkable than many others. It consists of a square and a circle, touching one another; the sides of the square being about nine hundred feet in length, and the circle a little more than a thousand feet in diameter. The square had eight doorways, one at each angle, and one in the middle of each side, every doorway being covered by a mound. The circle was peculiar in having a double embankment. This work, alas! has been entirely destroyed; and many others have also disappeared, or are being gradually obliterated by the plough. Under these circumstances, we read with pleasure that "The Directors of the Ohio Land Company, when they took "possession of the country at the mouth of the Muskingum River "in 1788, adopted immediate measures for the preservation of these "monuments. To their credit be it said, one of their earliest official "acts was the passage of a resolution, which is entered upon the "Journal of their proceedings, reserving the two truncated pyramids "and the great mound, with a few acres attached to each, as public "squares." Such enlightened conduct deserves the thanks of Archæologists, and we sincerely hope that the Company has prospered.

Both as being the only example of an enclosure yet observed in Wisconsin, and also as having in many respects a great resemblance to a fortified town, the ruins of Aztalan are well worthy of attention. They are situated on the west branch of Rock River, and were discovered in 1836 by N. F. Hyer, Esq. who surveyed them hastily, and published a brief description, with a figure, in the 'Milwaukie Advertiser.' In 'Silliman's American Journal,' No. XLIV. is a paper on the subject by Mr. Taylor, from which was derived the plan and the short account given by Messrs. Squier and Davis * The most complete description is contained in Mr. Lapham's 'Antiquities of Wisconsin.' † The name "Aztalan" was given to this place by Mr. Hyer, because the Aztecs had a tradition that they originally came from a country to the north, which they called Aztalan. It is said to be derived from two Mexican words, Atl, water, and An, near. "The main "feature of these works is an enclosure of earth (not brick, as has "been erroneously stated), extending around three sides of an irre-"gular parallelogram;" the river "forming the fourth side on the "east. The space thus enclosed is seventeen acres and two-thirds. "The corners are not rectangular, and the embankment or ridge is "not straight." "The ridge forming the inclosure is 631 feet long "at the north end, 1419 feet long on the west side, and 700 feet on "the south side; making a total length of wall of 2750 feet. The "ridge or wall is about 22 feet wide, and from one foot to five in "height. The wall of earth is enlarged on the outside, at nearly "regular distances, by mounds of the same material. They are called "buttresses, or bastions; but it is quite clear that they were never "intended for either" the one or the other. They vary from sixty-

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* L. c. p. 131.

† P. 41.

one to ninety-five feet apart, the mean distance being eighty-two feet. Near the south-west angle are two outworks, constructed in the same way as the main embankment.

In many places the earth forming the walls appears to have been burnt. "Irregular masses of hard reddish clay, full of cavities, bear "distinct impressions of straw, or rather wild hay, with which they "had been mixed before burning." "This is the only foundation for "calling these 'brick walls.' The 'bricks' were never made into any "regular form, and it is even doubtful whether the burning did not "take place in the wall after it was built." Some of the mounds, or buttresses, though forming part of an enclosure, were also used for sepulchral purposes, as was proved by their containing skeletons in a sitting posture, with fragments of pottery. The highest point inside the enclosure is at the south-west corner, and is "occupied by a "square truncated mound, which . . . . presents the appearance of a "pyramid, rising by successive steps like the gigantic structures of "Mexico." "At the north-west angle of the inclosure is another "rectangular, truncated, pyramidal elevation, of sixty-five feet level "area at the top, with remains of its graded way, or sloping ascent, "at the south-west corner, leading also towards a ridge that extends "in the direction of the river."

Within the enclosure are some ridges about two feet high, and connected with them are several rings, or circles, which are supposed to be the remains of mud houses. "Nearly the whole interior of the "inclosure appears to have been either excavated or thrown up into "mounds and ridges; the pits and irregular excavations being quite "numerous over much of the space not occupied by mounds." In these excavations and ridges, also, we should be inclined to see the ruins of houses. Some years ago a skeleton was found in one of the mounds, wrapped apparently in cloth of open texture, "like the coarsest linen fabric;" but the threads were so entirely rotten, as to make it quite uncertain of what material they were made.

The last Indian occupants of this interesting locality had no tradition as to the history or the purpose of these Earthworks.

Among the Northern tribes of existing Indians there do not appear to be any earthworks corresponding to these so-called Sacred Enclosures. "No sooner, however, do we pass to the southward, "and arrive among the Creeks, Natchez, and affiliated Floridian tribes, "than we discover traces of structures which, if they do not entirely "correspond with the regular earthworks of the West, nevertheless "seem to be somewhat analogous to them."* These tribes, indeed, appear to have been more civilized than those to the North, since they were agricultural in their habits, lived in considerable towns, and had a systematized religion, so that, in fact, they must have occupied a position, as well economically as geographically, intermediate between the powerful monarchies of Central America and the hunting tribes of the North. The "structures" to which Mr. Squier alludes, are described by him both in his 'Second Memoir,' and also in the 'Ancient Monuments of the Mississippi Valley,' (p. 120.) The "Chunk Yards," now or lately in use among the Creeks, and which have only recently been abandoned among the Cherokees, are rectangular areas, generally occupying the centre of the town, closed at the sides, but with an opening at each end. They are sometimes from six to nine hundred feet in length, being largest in the older towns. The area is levelled and slightly sunk, being surrounded by a low bank formed of the earth thus obtained. In the centre is a low mound, on which stands the Chunk Pole, to the top of which is some object which serves as a mark to shoot at. Near each corner at one end, is a small pole, about twelve feet high; these are called the "slave-posts," because in the "good old times" captives condemned to the torture, were fastened to them. The name "Chunk yard" seems to be derived from an Indian game called "Chunke," which was played in them,

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* Squier, l. c. p. 136.

At one end of, and just outside this area, stands generally a circular eminence, with a flat top, upon which is elevated the Great Council House.

At the other end is a flat-topped, square eminence, about as high as the circular one just mentioned, "upon this stands the public square."

These, and other accounts given by early travellers among the Indians, certainly throw much light on the circular and square enclosures; but some of those, classed by Messrs. Squier and Davis under this head, seem to us to be the slight fortifications which surrounded villages, and were undoubtedly crowned by stockades. We have already seen that the position of the ditch is in reality no argument against this view; nor does the position of the works seem conclusive, if we suppose that the works were intended less to stand a regular siege than to guard against a sudden attack.

Sepulchral Mounds.

The *Sepulchral* mounds are very numerous. "To say that they "are innumerable in the ordinary sense of the term, would be no "exaggeration. They may literally be numbered by thousands and "tens of thousands." They vary from six to eighty feet in height; generally stand outside the enclosures: are often isolated, but often also in groups; they are usually round, but sometimes elliptical or pear-shaped. They cover generally a single skeleton, which however is often burnt. Occasionally there is a stone cist, but urn burial also prevailed to a considerable extent, especially in the Southern States. The contracted position of the corpse seems to be as usual as in the more ancient burials of Europe. Implements both of stone and metal occur frequently; but while personal ornaments, such as bracelets, perforated plates of copper, beads of bone, shell, or metal, and similar objects, are very common, weapons are but rarely found; a fact which, in the opinion of Dr. Wilson, "indicates a totally different condition of society and mode of thought" from that of the present Indian. Plates of mica are very generally present, and in some cases the skeleton is entirely covered by them.

What now is the "idea" implied in these, often gigantic tumuli, and in the disposition of the corpse? The reason suggested by M. Troyon for the contracted position of the body, has already been mentioned in this Journal. Dr. Wilson appears to regard the tumulus as a simple development of that little heap of earth, "displaced by interment, which still to thousands suffices as the most touching memorial of the dead." Probable as these suggestions may appear, we confess that if we were to express an opinion we should lean rather to the opinion of the illustrious Swedish Antiquary, Prof. Nillson, and imagine that the grave was but an adaptation, a copy, or a development of the dwelling-place. Unable to imagine a future altogether different from the present, or a world quite unlike our own, primitive nations seem always to have buried with their dead those things which in life they valued most; with ladies, their ornaments; with chiefs, their weapons, and sometimes also their wives. They burned the house with its owner; the grave was literally the dwelling of the dead. According to Prof. Nillson, when a great man died, he was placed in his favourite seat, food and drink were arranged before him, his weapons were placed at hand, and his house was closed, sometimes for ever, sometimes to be opened once more, when his wife or his children had joined him in the land of spirits. The ancient tumuli in Northern Europe, which never contain metal, consist usually of a passage leading into a central vault, in which the dead "sit." At Goldhavn, in the year 1830, a grave of this kind was opened, and numerous skeletons were found sitting on low seats round the walls, each with their weapons and ornaments. The description given by Capt. Graah of the Eskimo "winter-house," and Scoresby's account of those belonging to the Greenlanders, agree closely with these graves, even to the fact that the passage points generally to the south or east, but never to the north. In a few cases tumuli have been examined which contained weapons, implements, ornaments, pottery, &c., but no human bones; in short, every indication of life, but no trace of death. Ernan also tells us that the graves of Tartars resemble their dwellings, a statement which Nillson apparently considers to be true of all primitive nations. In the Sulu Islands it is the custom to desert any house in which a great man has died,* and Captain Cook mentions his having seen at Mooa certain houses raised on mounds, in which he was told "the dead had been buried."

Certain small tumuli found in America have already been regarded as the remains of mud villages. Mr. Dille* has examined and described some small tumuli observed by him in Missouri. He dug into several, but never succeeded in finding anything except coals and a few pieces of rude pottery, whence he concluded that they were the remains of mud houses.† The Mandans, Minatarees, and some other tribes also built their huts of earth, resting on a framework of wood.

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* St. John's Life in the Forests of the Far East, Vol. ii. p. 217.

On the other hand, there are some tumuli to which it would seem that this explanation is quite inapplicable, and which are full of human remains. This was long supposed to be the case with the great Grave Creek Mound, which indeed was positively described by Atwater,‡ to be full of human remains. This has turned out to be an error, but the statement is not the less true as regards other mounds. In conjunction with them may be mentioned the "bone pits," many of which are described by Mr. Squier.§ "One "of these pits discovered some years ago in the town of Cambria, "Niagara county, was estimated to contain the bones of several "thousand individuals. Another which I visited in the town of "Clarence, Erie county, contained not less than four hundred skele-"tons." A tumulus described by Mr. Jefferson in his 'Notes on Virginia,' was estimated to contain the skeletons of a thousand individuals, but in this case the number was perhaps exaggerated.

The description given by various old writers of the solemn "Festival of the Dead," satisfactorily explains these large collections of bones. It seems that every eight or ten years the Indians met at some place previously chosen, that they dug up their dead, collected the bones together, and laid them in one common burial place, depositing with them fine skins and other valuable articles.

Sacrificial Mounds.

"The name of Sacrificial Mounds," says Dr. Wilson, "has been "conferred on a class of ancient monuments, altogether peculiar "to the New World, and highly illustrative of the rites and cus-"toms of the ancient races of the Mounds. This remarkable "class of mounds has been very carefully explored, and their most "noticeable characteristics are, their almost invariable occurrence "within enclosures; their regular construction in uniform layers of "gravel, earth, and sand, disposed alternately in strata conformable "to the shape of the mound; and their covering a symmetrical altar "of burnt clay or stone, on which are deposited numerous relics, in "all instances exhibiting traces, more or less abundant, of their "having been exposed to the action of fire." The so-called "altar" is a basin, or table, of burnt clay, carefully formed into a symmetrical form, but varying much both in shape and size. Some are round, some elliptical, and others, squares or parallelograms, while in size they vary from two feet, to fifty feet by twelve or fifteen. The usual dimensions, however, are from five to eight feet. They are almost always found within sacred enclosures; of the whole number examined by Messrs. Squier and Davis, there were only four which were exterior to the walls of enclosures, and these were but a few rods distant from them.

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* Smithsonian Contributions, Vol. i. p. 136.
† Archæologia Americana, Vol i. p. 223.
‡ See also Lapham, l. c. p. 80.
§ L. c. p. 25, 56, 57, 68, 71, 73, 106, 107. Squier and Davis, l. c. p. 118, &c.

The "altar" is always on a level with the natural soil, and bears traces of long continued heat; in one instance, where it appears to have been formed of sand, instead of clay, the sand for a depth of two inches is discoloured as if fatty matter of some sort had been burned on it. In this case a second deposit of sand had been placed on the first, and upon this, stones a little larger than a hen's egg, were arranged so as to form a pavement, which strongly reminds us of the ancient hearths in the Danish Kjökkenmöddings.

In a few instances, traces of timber were found above the altar. Thus in one of the twenty-six tumuli forming the "Mound City" on the Scioto River, were found a number of pieces of timber, four or five feet long, and six or eight inches thick. "These pieces had "been of nearly uniform length; and this circumstance, joined to "the position in which they occurred in respect to each other and to "the altar, would almost justify the inference that they had sup"ported some funeral or sacrificial pile." * The contents of these mounds vary very much. The one just mentioned contained a quantity of pottery and many implements of stone and copper, all of which had been subjected to a strong heat. The pottery may have formed a dozen vessels of moderate size. The copper articles consisted of two chisels, and about twenty thin strips. About fifty or a hundred stone arrow-heads, some flakes, and two carved pipes, completed the list of articles found in this interesting tumulus. In another mound nearly two hundred pipes were buried. Generally speaking, the deposit is homogeneous. "That is to say, instead of "finding a large variety of relics, ornaments, weapons, and other "articles, such as go to make up the possessions of a barbarian "dignitary, we find upon one altar *pipes* only, upon another a "single mass of galena, while the next one has a quantity of pottery, "or a collection of spear heads, or else is destitute of remains, "except perhaps a thin layer of carbonaceous material. Such could "not possibly be the case upon the above hypothesis, for the spear, "the arrows, the pipe, and the other implements, and personal "ornaments of the dead, would then be found in connection with "each other." †

This conclusion does not seem to us altogether satisfactory; and although these altar-containing mounds differ in so many respects from the above-described tumuli, we still feel disposed to regard them as sepulchral rather than sacrificial. Not having, however, had the advantage of examining them for ourselves, we throw this out as a suggestion, rather than express it as an opinion. We confess that we feel much difficulty in understanding why "altars" should be covered up in this manner; we can call to mind no analogous case. On the other hand, if Prof. Nillson's suggestion with reference to ancient tumuli be correct, the long continued fire will offer no difficulty; while the wooden constructions, and the burnt bones will all be explicable on the hypothesis that we have before us a sepulchre, rather than a temple.

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* Squier and Davis, l. c. p. 151.

† Ditto, p. 160.

Nor does the "homogeneousness" of the deposits found in these mounds appear so decisive to us as to Messrs. Squier and Davis. Take, for instance, the cases in which pipes are found. The execution of these is so good that "pipe-carving" was no doubt a profession; the division of labour must have already begun. Exactly the same feeling which would induce them to bury weapons with the dead hunter, in order that he might supply himself with food in Hades as on earth; that feeling, which among some ancient nations suggested the placing of money in the grave, would account not only for the presence of these pipes, but also for their number. The hunter could use but few weapons, and must depend for success mainly on his strength and skill; whereas the pipe-seller, if he could use a pipe at all in the grave, might render his whole stock in trade available.

If, therefore, "the accumulated carbonaceous matter, like that "formed by the ashes of leaves or grass," which suggests to Prof. Wilson "the graceful offerings of the first-fruits of the earth, so "consonant to the milder forms of ancient sacrifice instituted in "recognition of the Lord of the Harvest," seems to us only the framework of the house, or the material of the funeral pyre; on the other hand, we avoid the conclusion to which he is driven, that on "the altars of the mound-builders, human sacrifices were made; "and that within their sacred enclosures were practised rites not less "hideous than those which characterized the worship which the "ferocious Aztecs are affirmed to have regarded as most acceptable "to their sanguinary gods."

Temple Mounds.

The class of mounds, called by Messrs. Squier and Davis "Temple Mounds," "are pyramidal structures, truncated, and generally "having graded avenues to their tops. In some instances they are "terraced, or have successive stages. But whatever their form, "whether round, oval, octangular, square, or oblong, they have invariably flat or level tops, of greater or less area." These mounds much resemble the Teocallis of Mexico, and had probably a similar origin. They are rare in the North, though examples occur even as far as Lake Superior, but become more and more numerous as we pass down the Mississippi, and especially on approaching the Gulf, where they constitute the most numerous and important portion of the ancient remains. Some of the largest, however, are situated in the North. One of the most remarkable is at Cahokia, in Illinois. This gigantic mound is stated to be *seven hundred feet* long, *five hundred* feet wide at the base, and *ninety* feet in height. Its solid contents have been roughly estimated at twenty millions of cubic feet.

Probably, however, these mounds were not used as temples only, but also as sites for dwellings, especially for those of the chiefs. We are told that among the Natchez Indians "the temples and the dwellings of the chiefs were raised upon mounds, and for every new "chief a new mound and dwelling were constructed." Again, Garcilego de la Vega, in his History of Florida, quoted by Mr. Haven,[*] says—"The town and house of the Cacique of Osachile are similar to "those of all other caciques in Florida, and, therefore, it seems best "to give one description that will apply generally to all the capitals, "and all the houses of the chiefs in Florida. I say, then, that the "Indians endeavour to place their towns upon elevated places; but "because such situations are rare in Florida, or that they find a difficulty in procuring suitable materials for building, they raise eminences in this manner. They choose a place to which they bring a "quantity of earth, which they elevate into a kind of platform two or "three pikes in height (from eighteen to twenty-five feet), of which "the flat top is capable of holding ten or twelve, fifteen or twenty "houses, to lodge the cacique, his family, and suite."

Animal Mounds.

Not the least remarkable of the American Antiquities are the *Animal Mounds*, which are principally, though not exclusively, found in Wisconsin. In this district "thousands of examples occur of "gigantic basso relievos of men, beasts, birds, and reptiles, all wrought "with persevering labour on the surface of the soil," while enclosures and works of defence are almost entirely wanting, the "ancient City of Aztalan" being, as is supposed, the only example of the former class.

The "Animal Mounds" were first observed by Mr. Lapham in 1836, and described in the newspapers of the day, but the first account of them in any scientific journal was that by Mr. R. C. Taylor, in the American Journal of Science and Art, for April, 1838. In 1843 a longer memoir, by Mr. S. Taylor, appeared in the same journal. Professor J. Locke gave some account of them in a "Report on the Mineral Lands of the United States," presented to Congress in 1840. Messrs. Squier and Davis devoted to the same subject a part of their work on the "Ancient Monuments of the Mississippi Valley;" and finally, the seventh volume of the Smithsonian Contributions contains the work, by Mr. Lapham, which we have placed at the head of this article. Dr. Wilson does not appear to have made any original observations on this branch of the subject, but in a chapter on "Symbolic Mounds," he has given an interesting summary derived from these sources.

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[*] L. c. p. 57.

Mr. Lapham gives a map, showing the distribution of these curious earthworks. They appear to be most numerous in the Southern Counties of Wisconsin; and extend from the Mississippi to Lake Michigan, following generally the courses of the river, and being especially numerous along the great Indian trail or war-path from Lake Michigan, near Milwaukie, to the Mississippi, above Prairie du Chien. This, however, does not prove any connection between the present Indians and the mounds, as the same line has been adopted as the route of the United States military road.

The mounds themselves not only represent animals, such as men, buffaloes, elks, bears, otters, wolves, raccoons, birds, serpents, lizards, turtles, and frogs, but also some inanimate objects; if at least the American archæologists are right in regarding some of them as crosses, tobacco-pipes, &c.

Many of the representations are spirited and correct, but others, probably through the action of time, are less definite; one, for instance, near the village of Muscoda, may be either "a bird, a bow and arrow, or the human figure." Their height varies from one to four feet, sometimes, however, rising to six feet, and as a "regular elevation of six inches can be readily traced upon the level Prairies" of the West, their outlines are generally distinctly defined where they occupy favourable positions. It seems probable that many of the details have disappeared under the action of rain and vegetation. At present a "man" consists generally of a head and body, two long arms and two short legs, no other details being visible. The "birds" differ from the "men" principally in the absence of legs. The so-called "lizards," which are among the most common forms, have a head, two legs, and a long tail; the side view being represented, as is, indeed, the case with most of the quadrupeds.

One remarkable group in Dale County, close to the Great Indian trail, consists of a man with extended arms, seven more or less elongated mounds, one tumulus and six quadrupeds. The length of the human figure is one hundred and twenty-five feet, and it is one hundred and forty feet from the extremity of one arm to that of the other. The quadrupeds vary from ninety to a hundred and twenty-six feet in length.

At Waukesha are a number of mounds, tumuli, and animals, including several "lizards," a very fine "bird," and a magnificent "turtle." "This, when first observed, was a very fine specimen of "the art of mound-building, with its graceful curves, the feet pro-"jecting back and forward, and the tail, with its gradual slope, so "acutely pointed, that it was impossible to ascertain precisely where "it terminated. The body was fifty-six feet in length, and the tail “two hundred and fifty; the height six feet.” This group of mounds is now, alas, covered with buildings. “A dwelling-house stands on “the body of the turtle, and a Catholic church is built upon the “tail.”

“But,” says Mr. Lapham, “the most remarkable collection of “lizards and turtles yet discovered is on the school section, about a “mile and a half south-east from the village of Pewaukee. This consists of seven turtles, two lizards, four oblong mounds, and one of “the remarkable excavations before alluded to. One of the turtle “mounds, partially obliterated by the road, has a length of four hundred and fifty feet; being nearly double the usual dimensions. “Three of them are remarkable for their curved tails, a feature here “first observed.”

In several places a very curious variation occurs. The animals, with the usual form and size, are represented not in relief, but in intaglio; not by a mound, but by an excavation.

The few “animal mounds” which have been observed out of Wisconsin differ in many respects from the ordinary type. Near Granville, in Ohio, on a high spur of land, is an earthwork known in the neighbourhood as the “Alligator.” It has a head and body, four sprawling legs, and a curled tail. The total length is two hundred and fifty feet; the breadth of the body forty feet; and the length of the legs thirty-six feet. “The head, shoulders, and rump are more elevated than the other parts of the body, an attempt having evidently been made to preserve the proportions of the object copied.” The average height is four feet, at the shoulders six. Still more remarkable, however, is the great serpent in Adams County, Ohio. It is situated on a high spur of land, which rises a hundred and fifty feet above Brush Creek. “Conforming to the curve of the “hill, and occupying its very summit, is the serpent, its head resting “near the point, and its body winding back for seven hundred feet, “in graceful undulations, terminating in a triple coil at the tail. “The entire length, if extended, would be not less than one thousand “feet. The accompanying plan, laid down from accurate survey, “can alone give an adequate conception of the outline of the work, “which is clearly and boldly defined, the embankment being upwards “of five feet in height by thirty feet base at the centre of the body, “but diminishing somewhat toward the head and tail. The neck of “the serpent is stretched out, and slightly curved, and its mouth is “opened wide, as if in the act of swallowing or ejecting an oval figure, “which rests partially within the distended jaws. This oval is formed “by an embankment of earth, without any perceptible opening, four “feet in height, and is perfectly regular in outline, its transverse and “conjugate diameters being one hundred and sixty and eighty feet “respectively.”

When, why, or by whom these remarkable works were erected, as yet we know not. The present Indians, though they look upon them with reverence, can throw no light upon their origin. Nor do the contents of the mounds themselves assist us in this inquiry. Several of them have been opened, and "in the process of grading the streets of Milwaukie" "many of the mounds were entirely removed," but the only result has been to show that they are not sepulchral, and that, excepting by accident, they contain no implements or ornament.

Under these circumstances speculation would be useless; we can but wait and hope that time and perseverance may solve the problem, and explain the nature of these remarkable and mysterious monuments.

Inscriptions.

There is one class of objects which I have not yet mentioned, and which yet ought not to be left entirely unnoticed.

The most remarkable of these is the celebrated Dighton Rock on the east bank of the Taunton River. Its history, and the various conclusions which have been derived from it, are very amusingly given by Dr. Wilson.* In 1783, the Rev. Ezra Stiles, D.D., President of Yale College, when preaching before the Governor of the State of Connecticut, appealed to this rock, inscribed, as he believed, with Phœnician characters, for a proof that the Indians were descended from Canaan, and were therefore accursed. Count de Gebelin regarded it as a Carthaginian inscription. In the 8th vol. of the 'Archæologia,' Colonel Vallency endeavours to prove that it is Siberian; while certain Danish antiquaries regarded it as Runic, and thought that they could read the name "Thorfinn," "with an exact, "though by no means so manifest, enumeration of the associates who, "according to the Saga, accompanied Karlsefne's expedition to Vin-"land, in A.D. 1007." Finally, Mr. Schoolcraft submitted a copy of it to Chingwauk, an intelligent Indian Chief, who "interpreted it as "the record of an Indian triumph over some rival native tribe," but without, we believe, offering any opinion as to its antiquity.

In the "Grave Creek Mound" was found a small oval disk of white sandstone, on which were engraved twenty-two letters. Mr. Schoolcraft, who has especially studied this relic, finally concludes, after corresponding with many American and European archæologists, according to Dr. Wilson, that of these twenty letters, four corresponded with ancient Greek,† four with the Etruscan, five with the old Northern Runes, six with the ancient Gaelic, seven with the old Erse, ten with the Phœnician, fourteen with the Anglo-Saxon, and sixteen with the Celtiberic; besides which possibly equivalents may be found in the old Hebrew. "It thus appears that this ingenious "little stone is even more accommodating than the Dighton Rock; in "adapting itself to all conceivable theories of ante-columbian coloni-"sation." A stone of such doubtful character could prove little under any circumstances; but it must also be mentioned that "Dr. "James W. Clemens communicated to Dr. Morton all the details of

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* Vol. ii p. 172.

† Do. Vol. ii. p. 180.

" the exploration of the Grave Creek Mound; . . . without " any reference to the discovery of the inscribed stone. Nor was it " till the excavated vault had been fitted up by its proprietor for exhibition, to all who cared to pay for the privilege of admission, that " the marvellous inscription opportunely came to light to add to the " attractions of the show."

One or two other equally doubtful cases are upon record, but upon the whole we may safely assert that there is no reason to suppose that the nations of America had developed for themselves anything corresponding to an alphabet. The picture-writing of the Aztecs and the Quipa of the Peruvians, was replaced among the North American Indians by the " wampum." This curious substitute for writing consisted of variously-coloured beads, generally worked upon leather. One very interesting example is the belt of wampum " delivered by the Lenni Lenape Sachems to the founder of Pennsylvania, at the Great Treaty, under the elm-tree at Shachamox in 1682." It is still preserved in the collection of the Historical Society at Philadelphia, and consists of " eighteen strings of wampum formed of white and violet beads worked upon leather thongs," the whole forming a belt twenty-eight inches long, and two-and-a-half broad. " On this five " patterns are worked in violet beads on a white ground, and in the " centre Penn is represented taking the hand of the Indian Sachem." The large number of beads found in the tumuli were perhaps in a similar manner intended to commemorate the actions and virtues of the dead.

THE MOUND BUILDERS.

Just as the wigwam of the recent Mandan consisted of an outer layer of earth supported on a wooden framework, so also, in the ancient sepulchral tumuli, the body was protected only by beams and planks, so that when these latter decayed, the earth sank in and crushed the skeleton within. Partly from this cause, and partly from the habit of burying in ancient tumuli, which makes it sometimes difficult to distinguish the primary from secondary interments, it happens that from so many thousand tumuli we have only three skulls which indisputably belong to the ancient race. These are decidedly brachycephalic; but it is evident that we must not attempt to build much upon so slight a basis.

No proof of a knowledge of letters, no trace of a burnt brick have yet been discovered, and so far as we may judge from their arms, ornaments, and pottery, the mound-builders closely resembled some at least of the recent Indian tribes; and the earthworks resemble in form, if they differ in magnitude from those still, or until lately, in use. Yet this very magnitude is sufficient to show that, at some early period, the great river valleys of the United States must have been very much more densely populated than they were when first discovered by Europeans. The immense number of small earthworks, and the mounds, " which may be counted by thousands and tens of thousands," might indeed be supposed to indicate either a long time or a great population; but in other cases we have no such alternative. The Newark constructions; the mound near Florence in Alabama, which is forty-five feet in height by four hundred and forty feet in circumference at the base, with a level area at the summit of one hundred and fifty feet in circumference; the still greater mound on the Etowah River also in Alabama, which has a height of more than seventy-five feet, with a circumference of twelve hundred feet at the base, and one hundred and forty at the summit; the embankments at the mouth of the Scioto River, which are estimated to be twenty miles in length; the great mound at Selserstown, Mississippi, which covers six acres of ground; and the truncated pyramid at Cahokia, to which we have already alluded; these works, and many others which might have been quoted, indicate, we think, a population large and stationary; for which hunting cannot have supplied enough food; and which must, therefore, have relied in a great measure upon agriculture for its support. "There is not," say Messrs. Squier and Davis, "and there was "not in the sixteenth century, a single tribe of Indians (north of the "semi-civilized nations) between the Atlantic and the Pacific, which "had means of subsistence sufficient to enable them to apply, for "such purposes, the unproductive labour necessary for the work; "nor was there any in such a social state as to compel the labour of "the people to be thus applied." We know also that many, if not most of the Indian tribes, still cultivated the ground to a certain extent, and there is some evidence that even within historic times this was more the case than at present. Thus De Nonville estimates the amount of Indian corn destroyed by him in four Seneca villages at 1,200,000 quarters.

Mr. Lapham* has brought forward some ingenious arguments for thinking that the forests of Wisconsin were at no very distant period much less general than at present. In the first place, the largest trees are probably not more than five hundred years old; and large tracts are now covered with "young trees, where there are no traces "of antecedent growth."

Again, every year many trees are blown down, and frequent storms pass through the forest, throwing down nearly everything before them. Mr. Lapham gives a map of these windfalls in one district; they are very conspicuous, firstly, because the trees, having a certain quantity of earth entangled among their roots, continue to vegetate for several years; and, secondly, because even when the trees themselves have died and rotted away, the earth so torn up forms little mounds, which are often mistaken by the inexperienced for Indian graves. "From the paucity of these little 'tree-mounds,' "we infer that no very great antiquity can be assigned to the dense "forests of Wisconsin, for during a long period of time, with no material change of climate, we would expect to find great numbers of

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* L. c. p. 90.

" these little monuments of ancient storms scattered everywhere over " the ground."

But there is other more direct evidence of ancient agriculture. In many places the ground is covered with small mammillary elevations, which are known as Indian corn-hills. " They are without " order of arrangement, being scattered over the ground with the " greatest irregularity. That these hillocks were formed in the manner indicated by their name, is inferred from the present custom of " the Indians. The corn is planted in the same spot each successive " year, and the soil is gradually brought up to the size of a little hill " by the annual additions." * But Mr. Lapham has also found traces of an earlier and more systematic cultivation. These consist " of " low, parallel ridges, as if corn had been planted in drills. They " average four feet in width, twenty-five of them having been counted " in the space of a hundred feet; and the depth of the walk between " them is about six inches. These appearances, which are here denominated 'ancient garden-beds,' indicate an earlier and more perfect " system of cultivation than that which now prevails; for the present Indians do not appear to possess the ideas of taste and order " necessary to enable them to arrange objects in consecutive rows. " Traces of this kind of cultivation, though not very abundant, are " found in several other parts of the State " (Wisconsin).

Date.

In the ancient monuments of the Mississippi Valley it is stated that no earthwork has ever been found on the first or lowest terrace of any of the great rivers, and that "this observation is confirmed " by all who have given attention to the subject." If true, this would indeed have indicated a great antiquity, but in his subsequent work Mr. Squier informs us that " they occur indiscriminately upon " the first and upon the superior terraces, as also upon the islands of " the lakes and rivers." Messrs. Squier and Davis† are of opinion that the decayed state of the skeletons found in the mounds may enable us to form " some approximate estimate of their remote antiquity," especially, when we consider that the earth round them " is wonderfully compact and dry, and that the conditions for their preservation are exceedingly favourable." " In the barrows of " the Ancient Britons," they add, " entire well preserved skeletons " are found, although possessing an undoubted antiquity of at least " eighteen hundred years." Dr. Wilson‡ also attributes much importance to this argument, which, in his opinion, " furnishes a " stronger evidence of their great antiquity than any of the proofs " that have been derived either from the age of a subsequent forest " growth, or the changes wrought on the river terraces where they " most abound." This argument, if it proves anything, certainly requires a much longer time than eighteen hundred years, and carries us back therefore far beyond any antiquity indicated by the forests. These, nevertheless, have also a tale to tell. Thus Captain Peck* observed near the Ontonagon River, and at a depth of twenty-five feet, some stone mauls and other implements in contact with a vein of copper. Above these was the fallen trunk of a large cedar, and "over all grew a hemlock tree, the roots of which spread entirely above the fallen tree" . . . . . and indicated in his estimation, a growth of not less than three centuries, to which must then be added the age of the cedar, which indicates a still "longer succession "of centuries, subsequent to that protracted period during which "the deserted trench was slowly filled up with accumulations of "nany winters."

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* Lapham, l. c. p. 19. † L. c. p. 168. ‡ L. c. Vol. i. p. 359.

The late President Harrison, in an address to the Historical Society of Ohio, made some very philosophical remarks on this subject, which are quoted by Messrs. Squier and Davis.† "The "process," he says, "by which nature restores the forest to its "original state, after being once cleared, is extremely slow. The rich "lands of the West are, indeed, soon covered again, but the character "of the growth is entirely different, and continues so for a long period. "In several places upon the Ohio, and upon the farm which I "occupy, clearings were made in the first settlement of the country, "and subsequently abandoned and suffered to grow up. Some of "these new forests are now sure of fifty years' growth, but they "have made so little progress towards attaining the appearance of "the immediately contiguous forest, as to induce any man of reflection to determine that at least ten times fifty years must elapse "before their complete assimilation can be effected. We find in "the ancient works all that variety of trees which give such unrivalled beauty to our forests, in natural proportions. The first "growth on the same kind of land, once cleared and then abandoned "to nature, on the contrary, is nearly homogeneous, often stinted "to one or two, at most three kinds of timber. If the ground has "been cultivated, the yellow locust will thickly spring up; if not "cultivated the black and white walnut will be the prevailing "growth. * * * * * Of what immense age then must be "the works so often referred to, covered as they are by at least the "second growth, after the primitive forest state was regained?"

We get another indication of antiquity in the "garden beds," which we have already described. This system of cultivation has long been replaced by the simple and irregular "cornhills;" and yet, according to Mr. Lapham,‡ the garden beds are much more recent than the mounds, across which they extend in the same manner as over the adjoining grounds. If, therefore, these mounds belong to the same era as those which are covered with wood, we get thus indications of three periods; the first, that of the mounds themselves ; the second, that of the garden beds; and the third, that of the forests.

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* Willson, c. Vol. i. p. 256.

† L. c. p. 306.

‡ L. c. p. 19.

But American agriculture was not imported from abroad; it resulted from, and in return rendered possible, the gradual development of American semi-civilisation. This is proved by the fact, that the grains of the Old World were entirely absent, and that American agriculture was founded on the Maize, an American plant. Thus, therefore, we appear to have indications of four long periods.

1. That in which, from an original barbarism, the American tribes developed a knowledge of agriculture and a power of combination.

2. That in which the mounds were erected and other great works undertaken.

3. The age of the "garden beds," which occupy some at least of the mounds. Hence it is evident that this cultivation was not until after the mounds had lost their sacred character in the eyes of the occupants of the soil; for it can hardly be supposed that works executed with so much care would be thus desecrated by their builders.

And 4. The period in which man relapsed into barbarism, and the spots which had been first forest, then (perhaps) sacred monuments, and thirdly cultivated ground; relapsed into forest once more.

But even if we attribute to these changes all the importance which has ever been claimed for them, they will not require an antiquity of more than three thousand years. We do not, of course, deny that the period may have been very much greater, or very much less, but, in our opinion at least, it need not be greater. At the same time there are other observations, which, if they shall eventually prove to be correct, would indicate a very much greater antiquity.

One of these is an account "given of a Mastodon found in Gas-"conade County, Missouri, which had apparently been stoned to "death by the Indians, and then partially consumed by fire. The "pieces of rock, weighing from two to twenty-five pounds each, which "must have been brought from a distance of four or five hundred "yards 'were,' says the narrator, 'evidently thrown with the inten-"tion of hitting some object.' Intermixed with burned wood and "burned bones, were broken spears, axes, knives, &c., of stone." This statement, which, if true, is of the highest importance, is given by Mr. Haven* without a word of caution, and is repeated by Dr. Wilson.† Both these gentlemen refer to the 'American Journal of Sciences and Art' (First Series, Vol. xxxvi. p. 199), as if they were quoting from an article communicated to that respectable journal. Now, the fact is, that the only authority for the statement is an anonymous correspondent of the 'Philadelphia Presbyterian.' The editor of the American Journal, while reprinting the communication, inserted a notice requesting the author to make himself known and to give some more particulars. I cannot, however, ascertain that, in answer to this appeal, any one came forward to take upon himself the responsibility of so important an observation.

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* L. c. p. 142.

† L. c. v. i. p. 112.

Nor is this all. The original communication to the 'Philadelphia Presbyterian' *never alludes to the Mastodon at all*, but refers the skeleton to the Mammoth; and the Mastodon was first suggested by the editor of the American Journal. Under these circumstances it certainly seems to us that some better evidence will be required before we can be expected to believe that any Mastodon was ever stoned to death by North American Indians.

There are, indeed, upon record other facts of a similar tendency. We have, however, already exceeded our limits, and we will therefore defer the consideration of them to some future opportunity.

If, however, the facts above recorded justify the conclusion that parts at least of North America once supported a numerous and agricultural population, then we cannot but ask, What fatal cause has destroyed this earlier civilisation? Why are these fortifications forsaken—these cities in ruins? How were the populous nations which once inhabited the rich American valleys reduced to the poor tribes of savages which the Europeans found there? History suggests by luxury or war. And the Archæologist, if he perceive little evidence of the first, finds abundant proof of the second. Did, then, the North and the South once before rise up in arms against one another? "Did the terrible appellation of 'The Dark and Bloody Land,' applied to Kentucky, commemorate these ancient wars?" Absit omen. Let us hope that our kinsmen in America may yet pause ere they, in like manner, sacrifice a common prosperity to a mutual hatred.

II.—PREHISTORIC MAN: RESEARCHES INTO THE ORIGIN OF CIVILISATION IN THE OLD AND NEW WORLD. By Daniel Wilson, LL.D.

THIS work would have corresponded more nearly with its title if it had been called 'An Introduction to American Archæology,' or, in accordance with Dr. Wilson's earlier work, 'The Prehistoric Annals of America.' It is true that he has some general chapters; such as one on "Speech," another on "Instinct," and a third on "Fire," or, as he prefers to call them, "The Primeval Occupation: Speech," "The Primeval Transition: Instinct," and "The Promethean Instinct: Fire." The second of these headings we must confess that we cannot understand, nor have two careful perusals of the chapter itself thrown any light upon the meaning; but surely "speech" is as much an occupation now as it was in the earliest times? However this may be, these chapters are at least general and correspond to the title of the work, while by far the larger part of the work is entirely devoted to the description of American antiquities.

In some respects, perhaps, Dr. Wilson's work might be shortened with great advantage; thus, in alluding to Kent's Cavern, it was surely unnecessary to transcribe Macaulay's well-known description of Torquay. Extensive reading, great power of word-painting, and impetuous enthusiasm render Dr. Wilson's statements sometimes obscure if not contradictory. His very last paragraph is an eloquent expression of his satisfaction that, in the light which archæology has thrown on the age of man, there is "a welcome evidence of "harmony between the disclosures of science and the dictates of revelation." Had, then, the Doctor any secret misgivings on this point? Such a state of mind is a mystery to us; but, indeed, this is not the only occasion in which the Doctor, clear enough on purely scientific questions, becomes unintelligible as soon as he treads on sacred ground. For instance, at the close of his chapter on the "Primeval Instinct," he says, "And now that it seems almost certainly demon-"strable on archæological, and also on geological grounds, that the "human family was widely dispersed over the face of the earth at the "earliest possible date at which we can reconcile chronologies of "science and revelation, possibly some may be tempted to return to "their old convictions, that when 'all the fountains of the great deep "were broken up, and the windows of heaven were opened, and the "rain was upon the earth forty days and forty nights; and the waters "prevailed exceedingly upon the earth; and all the high hills that "were under the whole heaven were covered,' that it actually "was so." The logic of this sentence has puzzled us very much, but the following statements with reference to instinct and reason are still more bewildering.

In Vol. i. p. 94, he says—"The Palæontogists' one perfect speci-"men of an extinct species, is for every purpose of science a speci-"men of all examples of such; even as the naturalists' history of one "specific zoophyte, ant, or beaver, is the history of all;" . . "of "their works, as of their organic structure, one example is a sufficient "type of the whole;" and then, after a quotation from 'Montgomery's Pelican Island,' he goes on to contrast this invariability of instinct with the diversity of human art. "But with the relics of human art, even in its most primitive and rudimentary forms, it is far otherwise. Each example possesses an individuality of its own;" and his conclusion is that "the instincts of the inferior orders of creation are in vain "compared with the devices of man." Now, in P. 161, he says—"The bee, according to Huber, when interrupted in its cell-building "operations, adapted its structure to the novel circumstances imposed "on it, altering the otherwise invariable hexagon. The bird, in like "manner, accommodates the form of its nest to the peculiarities of the "chosen locality; *as if making the instinctive process subservient to the "rational.*" Thus the cell and the nest which were so invariable in p. 94, are, in p. 161, modified as soon as "novel circumstances are imposed on" them. So also the individuality which, according to p. 94, is impressed on every example of human art, vanishes, in p. 264, as soon as we attempt to grapple with it. The primitive implements met with in ancient workings in Anglesea "correspond exactly with "those found on the shores of Lake Superior;" and "the modern "flint-lance or arrow-head of the Red Indian can scarcely be distin"guished from that found in the most ancient British graves;" while in Vol. ii. p. 109, the pottery of the North American Indians has become as "unvarying as the nest-building instinct of birds," which, however, as we have already seen, changes as soon as circumstances alter.

But, according to Dr. Wilson (Vol. i. p. 450), the remarkable correspondence between the domestic and sepulchral pottery of the Old and New World "is only the inevitable correspondence of the inartistic simplicity inseparable from all infantile art." If, then, "infantile art" shows such an "inevitable correspondence," how does he know that in the case of animals "Their most ingenious "works cost them no intellectual effort to acquire the craft, and ex"perience adds no improvements in all the continuous labours of the "wonderful mechanicians?" or how does he reconcile this with the very next paragraph, in which he says, "The ant and the beaver, the "coral zoophyte and the bee, display singular ingenuity and powers "of combination; and each feathered songster builds its nest with "wondrous forethought." Granting that the coral zoophyte displays singular ingenuity, which we are sure will be a new fact to naturalists, and admitting that birds show wondrous forethought, we *should* like to know how they manage to do so without any intellectual effort.

But we are thoroughly puzzled and bewildered, we can form no idea of what Dr. Wilson's opinions on these subjects really are, and our only conclusion is that, in the words of Lord Dundreary, it is one of those things which no fellow can understand.

But we should be doing the author great injustice if we were to insinuate that this is a fair specimen of the work. On the contrary, in spite of some deficiency of method, and a certain fulness of habit, the book is very readable, and may be recommended as an introduction to more special works on Archæology. The figures also are numerous and good.

In the chapter on "Narcotic Arts and Superstitions," he discusses at some length the question, whether smoking was known in Europe before the time of Columbus, as has been inferred by some antiquaries from the "Elfin pipes," which have been said to be found under circumstances implying great antiquity, and even on one occasion with a stone hatchet, and some arrow-heads. On the whole, he confesses, "that a full consideration of all the bearings of this disclo"sure of the sources of modern popular belief has greatly modified "the faith I once attached to such forms of tradition as memorials of "the past."

His account of the remarkable earthworks and tumuli which are so numerous in the United States, though containing little new, is well written, and will repay an attentive perusal. He gives also an amusing and instructive history of the various opinions which have been held by different Archeologists, on the nature of the Dighton Rock inscriptions, and some other doubtful relics; but as these antiquities are the subject of a special article which appears in another part of this review, we shall not here enter into any discussion of them.

In the chapter entitled "Ante-Columbian Traces: Colonization," Dr. Wilson examines the evidence as to a Scandinavian discovery of North America, and the conclusion to which he arrives is the following: "That the old Northmen visited some portions of the American coasts appears to be confirmed by most credible testimony; but "that their presence was transient, and that they left no enduring "evidence of their visits, seems little less than certain."

The dictum of Ulloa, "He who has seen one tribe of Indians, has "seen all," and the inference that the various nations of America (always excepting the Esquimaux) constitute a single variety of Man, have generally been accepted as true by American Ethnologists. "Lawrence, Wiseman, Agassiz, Squier, Gliddon, Nott, and Meigs might each be quoted in confirmation of this opinion." It has also the support of Morton, who, however, noticed the differences between the skulls of different tribes, but attributed them to artificial distortion. To this curious habit Dr. Wilson devotes a separate chapter, which is a valuable addition to our knowledge of the subject, and we regret that our space does not permit us to do justice to the facts which he has brought together. "The artificial forms," he says, "given to the human head by the various tribes among whom "the custom has been practised in ancient and modern times, though "divided by Dr. Gosse, of Geneva, into sixteen classes, range between two extremes. One of these is a combined occipital and "frontal compression, reducing the head as nearly as possible to a "disk, having its mere edge laterally . . . . The other form, "which is more common among the Flat-head tribes on the Columbia "river and its tributaries, depresses the forehead, and throws back "the whole skull . . . . Fashion regulates to some extent the "special form given to the head among various tribes, but this is "modified by individual caprice, and a considerable variety is observable in the strange shapes which it is frequently forced to assume." As illustrations he gives figures of a Nematee chief, a Flat-head child, anfl Caw-we-litcks, "a Flat-head woman."

It is certainly difficult to believe that such changes as are here portrayed can be produced without injury, and yet we are assured that they affect neither the health nor the intellect.

While, however, Dr. Wilson fully appreciates the importance of these observations, he denies that all the differences which distinguish the form of the head in different tribes, can be thus accounted for. He gives careful measurements of many American skulls, both ancient and modern, and after comparing them together he sums up the question as follows: "If differences of cranial conformation of

" so strongly defined a character as are thus shown to exist between " various ancient and modern people of America, amount to no more " than variations within the normal range of the common type, then " all the important distinctions between the crania of ancient European " barrows and those of living races, amount to little; and the more " delicate details . . . must be utterly valueless." The habit of burying the corpse in a sitting posture was also relied upon by Dr. Morton as an additional evidence of the unity of race in the American nations, but we quite agree with Dr. Wilson in attributing little value to this argument; it having been already shown in the columns of this Review that the habit in question was common to many ancient nations, and the most remote countries.

With reference to the source or sources of the American population, Dr. Wilson seems rather to incline towards a Polynesian origin, for though he admits that " many analogies confirm " the probability of some portion of the North American stock " having entered the Continent from Asia," still, if we have not misunderstood his meaning, he considers that " while, theoretically, the " northern passage seems so easy, yet so far as any direct proof goes, " the Polynesian entrance into the South, across the wide barrier of " the Pacific, is the one most readily sustained."

He must forgive us for quarrelling with his last chapter, entitled " Guesses at the Age of Man." " To those," indeed, he says, " who " can accept of (*sic*) a theory which would make man the mere latest " development of the same life-germ out of which all organic being " has been evolved by a process of natural selection, it is as difficult " to place limits to his possible existence, as to determine where the " ape or the faun ended and man began. But to those who still " believe that God made man 'in his own image,' the limits which " must be assigned to the existence of the race lie within moderate, " if undefined bounds."

We do not perceive the force of the argument, that moderate limits " must be assigned to the existence of the race," because " God made man in his own image;" nor can we too strongly reprobate the attempt to fix a stigma of irreligion on the theory of Natural Selection.

As far as science is concerned, his reason for this conclusion appears to be that history carries us back, in his opinion, to the infancy of human thought, so " that we seem to stand in need of no great " lapse of centuries between that and the beginning of man himself." We have not space to examine this reasoning, but must content ourselves with the simple statement. Our surprise at the result ceases when we discover that, in Dr. Wilson's opinion, the date of our creation has been revealed to us, but it is replaced by astonishment that, under these circumstances, he should still regard the Age of Man as a fit subject for " Guesses."

III.—GENERA PLANTARUM AD EXEMPLARIA IMPRIMIS IN HERBARIIS KEWENSIBUS SERVATA DEFINITA; auctoribus G. Bentham et J. D. Hooker. Vol. I. pars 1. 1862.

SINCE the publication of Endlicher's 'Genera Plantarum,' now above twenty years ago, no work of systematic botany equal in importance to this, of which we now welcome the first instalment, has appeared. Matters of late years have been growing absolutely desperate in this department of the science; a perfect chaos has been impending, and working botanists may well thank their stars for the dawning deliverance. Endlicher, though his book has many faults, did his work excellently well, all things considered; but since his time genera have been described as new at an amazing rate, particularly of late years, and as few or none keep interleaved copies of the old book to post these up as described, things have grown to such a pass that no one can safely tell what is new and what is old; generic synonymy is frightfully involved, and, hardened by circumstances, describers are emboldened to publish 'new' genera with infinitesimal chances of their being truly such. To give an example of this rapid increase of genera, reminding one of our colleague Mr. Currey's favourite Fungi—we count in the Bibliography of last year no fewer than 90 described as new, while in the previous year there were 123. Our authors themselves describe 47, almost all founded on specimens in the Kew Herbarium, encountered in the course of their reference to this collection, which has furnished the material basis for much that is valuable in their work, as indicated by their title-page; all the genera, of which specimens were there accessible to them, have been independently examined and endorsed. 'Characteres genericos saepius ad exemplaria specierum plurium confirmavimus,' we find in their brief 'Præmonenda.'

The new 'Genera Plantarum' differs in many respects from that of Endlicher, and almost every point of difference we count an improvement. We shall not enumerate these seriatim, nor discuss the many vivid contrasts which occur to us with the two works side by side, but rather endeavour to explain the features which characterize the new 'Genera,' and which render it in every way as useful as it seems to us it could possibly be made. The authors adopt, so far as they have progressed in this first part, a sequence of the higher groups, in the main that of A. P. De Candolle, followed in the 'Prodromus' and other systematic works of importance. There are, however, some modifications of the Candollean system introduced, to which we shall direct attention farther on.

The present part includes, in upwards of 400 well-printed pages, 56 Orders of Polypetalous Dicotyledons, from *Ranunculaceae* to *Connaraceae*. A synopsis or conspectus of these orders * is prefixed to the work. This is one of those carefully condensed summaries which matured experience alone could frame. As it has not been thought necessary to repeat either the diagnoses or names of the groups superior to Natural Orders in the body of the work, this synopsis of seven pages demands a brief notice. The Dicotyledonous Polypetals are divided into three 'Series'—*Thalamiflorae*, *Disciflorae*, and *Calyciflorae;* not into *Thalamiflorae* and *Calyciflorae* only, as in the 'Théorie Élémentaire.' The prominent introduction of a group of *Disciflorae* is a novel feature, and one the practical utility of which appears to us yet to be tried. At first sight it seems rather remarkable that a character of so great systematic importance should depend upon the development of the cellular thickening or expansion of the torus which we term disc; a development to which we are slow to assign organic independence, and which is found almost indifferently either between any of the floral verticils, or, in the opinion of some organogenists, exterior to them altogether; yet when we consider the high value always attributed to the insertion of the stamens, and to '*ovarium superum vel inferum*'—a value which experience has, we think, largely ratified;—and when we reflect further that, after all, these characters are essentially based upon the amount of adhesion between a theoretical disc and the ovary, we cease to wonder that the prevalence of a free disc inside or outside the stamens should be seized and applied as it has been by Messrs. Bentham and Hooker. With them it has been a choice of difficulties which few indeed are in a position fully to appreciate, and still fewer competent to choose between.

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* Excepting the last—Connaraceae, which is the first of the Calycifloral Series, to be continued in the next part.

The three 'Series' are briefly characterized as follows:—

I. *Thalamiflorae.* Calyx ab ovario saepissime liber. Petala 1-serialia v. saepe 2- ∞ -serialia. Stamina ∞ v. definita, toro saepius parvo v. elevato v. stipitiformi inserta. Ovarium saepissime superum.

II. *Disciflorae.* Calyx ab ovario saepius liber. Petala 1-serialia. Stamina saepius definita, intra v. supra v. circa torum in discum saepius expansum inserta. Ovarium saepius superum v. disco immersum.

III. *Calyciflorae.* Calycis tubus saepius ovarium fovens v. adnatus. Petala 1-serialia, calycis tubo inserta. Stamina ∞ v. definita, calycis tubo v. disco calycis tubum vestienti saepissime inserta. Ovarium saepe calycis tubo inclusum v. inferum.

The 'Series' are divided into 'Cohorts.' Thalamiflorae into six, viz., Ranales, Parietales, Polygalineae, Caryophyllineae, Guttiferales, Malvales; Disciflorae into four,—Geraniales, Olacales, Celastrales, Sapindales. In the latter Series we observe that the insertion of the ovule and relative position of the raphe, whether ventral or dorsal, are made use of as affording diagnostic characters for the Cohorts. The Natural Orders which happen to be more or less exceptional are noted under the '*Excepta*' of each Cohort, and this plan of indicating exceptional forms is further admirably carried out in the work under the head of '*Formae abnormes*,' which we find immediately following the description of each Order. We copy by way of example the abnormal forms of a small Order, Nymphæaceae, of which Nelumboneae and Cabombeae are regarded as Tribes.

> "Caulis mucilagine indutus, in *Cabombeis*.
>
> Folia basi cordata v. integra, nec peltata, in *Barclaya*, submersa dissecta in *Cabomba*.
>
> Petala et stamina definita in *Cabombeis*.
>
> Ovarium omnino inferum in *Victoria* et *Euryale*.
>
> Semina exalbuminosa, in *Nelumbone*. Testa villosa in *Barclaya*."

The descriptions of the Natural Orders appear to be extremely well drawn up. Appended to each is a short notice of the marks which distinguish it from nearest allies as well as from other groups which present only points of analogy, though these latter are more precisely indicated in the '*Genera affinia aut exclusa v. dubia*,' a list of which follows the '*Conspectus Generum*' of the Order. These lists of abnormal and of allied, excluded, or doubtful genera, &c., are very valuable indeed, and a great boon to working botanists. It would be utterly foreign to our present purpose to examine these in detail, and their criticism we are not bold enough to attempt. We have only cordially to thank Messrs. Bentham and Hooker for the pains which they have bestowed to make them so comprehensive.

Amongst the more important changes in the circumscription, &c. of the Natural Orders, we note Lardizabaleae constitute a tribe of Berberideae;* Calycanthaceae are brought between Dilleniaceae and Magnoliaceae, notwithstanding the apparently perigynous insertion of the stamens. This is shown to be due to an expansion of the torus, similar to that presented by *Eupomatia* and *Nymphaea*. Fumariaceae form a tribe of Papaveraceae; Pangieae of Bixineae. Frankeniaceae is maintained independently, and immediately precedes Caryophylleae, which latter includes Polycarpeae. Elatineae is also kept up near to Hypericineae; Rhizoboleae form a tribe of Ternströmiaceae. The changes introduced in the Malval Alliance have been already treated of by Mr. Bentham in the Linnean Society's Journal. Erythroxyleae and Ixonantheae are tribes of Lineae. *Nitraria* is referred to Zygophylleae. Geraniaceae includes Oxalideae and Balsamineae. Rutaceae is very comprehensive, embracing, besides Cusparieae and Diosmeae, &c., Zanthoxyleae and Aurantieae. *Balanites* and *Suriana* go into Simarubeae. Phytocreneae form a tribe of Olacineae. *Prinos* is reduced to *Ilex*; Hippocrateae to a tribe of Celastrineae. Stackhousieae and Sabiaceae are maintained ordinally distinct, while Acerineae and Staphyleae are reduced to tribes of Sapindaceae. Sabiaceae, we observe, appear in an entirely new aspect, not limited to the typical genus *Sabia*, but including also *Meliosma*, *Ophiocaryon*, and *Phoxanthus*. The Order is exceptional amongst Disciflorae from its stamens opposite to and isomerous with the petals. The order Coriarieae follows Anacardiaceae, and following it is Moringeae, which seems to have gone a little astray.

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* A new genus from Chili, received at Kew since the printing of the 'Genera Plantarum,' remarkably confirms the propriety of this union. It forms the connecting link of the two tribes.

As intimated above, a 'Conspectus Generum' precedes the generic descriptions of each Order; in some cases, as in Dipterocarpeae, based upon two separate sets of characters, derived from the flower and fruit. These synopses will save an immense amount of time, and are a feature most favourably in contrast with the 'Genera Plantarum' of Endlicher. The descriptions of genera mostly run about four to a page (3 to 5). These include synonymy, distribution, estimate of the number of species, and, in the case of the larger genera, the characters of the subgenera or sections usually adopted. With regard to these details we may quote from the 'Præmonenda.'

"Sub silentio praeterimus: 1. Nomina sectionalia pro generibus "propriis a nemine vindicata, 2. Nomina generica plurima in "herbariis v. catalogis proposita sed adhuc verbis non definita, nec "ab auctoribus recepta. 3. Nomina generica ab auctoribus quibus"dam jam antiquis imprimis a Mœnchio, Neckero, Adansonio, "Gmelinio proposita et jam diu in omnibus operibus systematicis ad "genera prius stabilita relata, nisi a Botanicis recentioribus vindican"tur. 4. Nomina generica magna copia a Rafinesquio temere pro"posita, et genera Maderensia Bowdichii certe falsa et nequaquam "recognoscenda."

We abstain for the present from discussing the many philosophical questions bearing upon physiological and morphological correlation, the comparative value of characters and the like, which an examination of a 'Genera Plantarum' is so apt to suggest, hoping to return to these as we notice the issue of the successive parts of this most valuable work, which all botanists must join with us in desiring may appear at intervals as short as the multitudinous engagements of its learned authors will permit.

IV.—The British Flora. Eighth Edition. 1860. By Sir W. J. Hooker, K.H. &c. and G. A. Walker Arnott, LL.D.

Manual of British Botany. Fifth Edition. 1862. By C. C. Babington, M.A. &c.

Handbook of the British Flora. 1858. By George Bentham.

Turning to the Bibliography of Phanerogamic Botany for 1861, contained in the last part of the Natural History Review, we took the pains a few evenings ago, to count the number of authors there enumerated, that we might reckon the proportion borne by English writers to the whole. Were it not that Botanical Bibliography is no new study of ours, we might, considering the energy of our Islanders, have fairly anticipated one-fourth at least of the names to be English, nay, a third of the list, for we must not forget that botanical publications of foreign lands are much more likely to escape the eye of the Bibliographer than those published in his own country. We know too well, however, our working botanists to be a small band, though in the main a zealous and worthy one, not to be rather surprised than otherwise, that out of about 250 names in the list, so many as 50 were countrymen. We include our Colonial workers. Of course the 50 are not all eminent botanists: some of them are plainly very much the reverse; but their analysis it would be very invidious indeed to attempt in this place, especially that we are hardly in a position in like manner to estimate the preponderant balance of 200. We do not wish to dwell upon the reflections which this counting suggested. In connection with it, however, one thing not new to us was recalled, and that was the belief that our British botanists are just now at a disadvantage, so far as such comparison as we speak of is concerned, in that they do not possess any organ or periodical in which to chronicle observations, such as those which occupy the Bulletin of the Botanical Society of France, or the numerous Verhandlungen, Zeitschriften, and Berichte of the different German States. A facility of publication doubtless may be hurtful both to writers and readers, but we do not apprehend that were a journal started after the plan of the Botanical Gazette of the lamented Mr. Henfrey, and under good and spirited management, it could tend to other than the promotion in every way of Botanical science, and that without pecuniary loss to its conductors. For the sake of our British botanists, *par excellence*, those who concern themselves chiefly or exclusively with our own Flora and its relations, it is to be regretted that the recent proposal for the establishment of a Botanical Journal under excellent auspices, was not more liberally encouraged and responded to. The Journal of the Linnean Society, though the best possible channel for the publication of many of the contributions of its Fellows, is scarcely open to, nor adapted for, the communications which it would be the business of a Journal more especially devoted to British botany to invite.

Though the proportion of English to foreign authors in the Bibliography above referred to be small, yet we may infer from the list of books heading this notice—one in its eighth, another in its fifth, and the third nearly out of its first edition, that the number more or less interested in our botany is tolerably large, not forgetting to allow that a large proportion of the copies sold, are for the rather temporary purposes of a three months course of lectures. It seems worth the while then, to look once again into these familiar books, to compare thoughts upon them, and, as they must exercise an influence of some kind upon the character and direction of the botanical pursuits of those who use them, to enquire whether this is likely to be of the right sort, and of the most useful.

"The principal object of a Flora of a country," Mr. Bentham says, "is to afford the means of *determining* (*i.e.* ascertaining the name of) any plant growing in it, whether for the purpose of ulterior study or of intellectual exercise." Here then is one test of primary importance, which we may try to apply to our three books. It is well to bear in mind that these works are consulted by two sets of persons—those who have a tolerably fair idea of the affinities of nearly every plant they gather, say know its genus or Natural Order—and those who have little or no conception of the kind. Although Prof. Babington intends his volume as a field-book or companion "for botanists," yet there seems no question, that he means it to be made use of also by beginners and amateurs, as do the authors of the other two works; Mr. Bentham expressly designing his Handbook for the use of such.

So far as these unfortunate beginners are concerned, we feel satisfied that in 9 cases out of 10, or at any rate 5 out of 6, they must experience great difficulty—much greater than it is easy for us to appreciate—in overcoming the obstacles presented by the first page of these Floras. A difficulty which we need not enter upon further than to observe, that it appears to us to be as well met as it is possible to be by Mr. Bentham, in the "Analytical Key" prefixed to his work: necessarily artificial, as he tells us, but none the less useful as a means to the "principal object" of the book. This plan has been adopted also by Prof. Babington, in the last edition of his Manual. It has been suggested to us, by one well experienced, that these keys might advantageously be preceded by an enumeration of the two or three anomalous Natural Orders or inferior groups, which are not intelligibly amenable to such treatment by curt alternatives. Coniferæ, Lemnaceæ, and Loranthaceæ are examples of such groups, in respect of which botanists are not always agreed as to their structure. They are plants which young students have no reasonable chance of comprehending. The suggestion is worth entertaining, though we do not think that in the case of Mr. Bentham's skilful analysis it is required. Prof. Babington says, that his "Analytical Key," on the plan of the French School of Botanists, has been "slightly modified, so as to be less likely to mislead." We fear *more* might too truly be substituted for *less*. The first pair of alternatives in his key—leaves straight-veined or net-veined—is one which the student must often find it very difficult to decide upon. Indeed the author himself, unless he can show the common Arum to have straight veins, must fail to trace it through his zigzags. The Mistletoe is another common plant, of which Prof. Babington's key makes a sad mess. The method of an analytical key to the Natural Orders and anomalous groups, and then in their turn to genera and species, is, of course, by no means new, having indeed been used so long ago as in the French Flora of Lamarck and De Candolle, though never generally in works on the British Flora. It is not without an objection, in the absolute character of its brief alternatives, and their incompatibility in a manner with the defiant variability and vagueness which plants so revel in; yet this objection may be to a great extent met by the special contriving of two or three routes to a goal, and all things considered, we are satisfied it is the best plan to adopt in a work intended for beginners as well as accustomed botanists. It is extremely difficult, if not impossible, to treat the definitions of Classes, Sub-classes, and Orders, and other larger divisions of Flowering Plants, in such a way that they shall be practically available to young botanists. An *Arum* or a *Tamus* is almost sure to be a Dicotyledon, while *Myriophyllum* and the like make excellent Monocotyledons. Nor is it possible they can decide the knotty question whether the Pine and Yew are naked-seeded or not.

The general plan of arrangement in the British Floras is the same; the Candollean sequence of the Orders being adopted. This is well, since the tendency on the part of some Continental botanists to distribute the Orders differently, in conformity with peculiar and not generally adopted views of affinity is detrimental to science, and without any advantage compensating for the great inconvenience thus occasioned to botanists, to whom facility of reference is of high importance. This applies to general features. There are little alterations, transpositions and combinations of Orders which might probably be made, perhaps in each of our works, but the general plan and sequence is too securely founded to be lightly deranged. Of these minor changes we may note as occurring to us by way of example, the Purslane Order, which we suppose Mr. Bentham would now place near the Pinks and Elatines. The Catkin Family certainly ought to be treated differently. We are constantly asked what is meant by *Amentaceæ*. Certainly no single Natural Order, as we understand such, can include the genera grouped under this term by Messrs. Bentham and Babington. These constitute an "Alliance" of Orders rather than an "Order." Prof. Babington does not mend matters by describing the ovary of his Amentiferæ as "usually simple," while seven of the ten genera mentioned have an ovary with two or more cells, in several of them adnate to the perianth; "simple" applied to this case, he tells us in his glossary, means "not compound."

While upon the subject of the larger groups we would point out that, general ordinal definitions might, in some instances, be made fuller with advantage in Mr. Bentham's Handbook, especially that his work is often found in the hands of students, who ought not to be satisfied with such a meagre notice as we find in the case of the Mignonette Family, which is surely as important to the British botanist as the Polemonium Family, described at some length. "Ovules inserted under the catkin-scales, or solitary and quite exposed," is not clear in the account of the Pine Family. If Onagraceæ rightly include *Hippuris*, "ovary sometimes one-celled" should be added.

Perhaps the most striking feature resulting from a comparison of our Floras is the wide difference in the value assigned to species by their respective writers. While Mr. Babington's Manual (Ed. iv.) contains 1708, Messrs. Hooker and Arnott have but 1571, and Mr.

Bentham 1285, or the extremes as 75·2 : 100. Hooker and Arnott have steadily adhered to a medium course in this respect, although even they maintain under some "critical" genera, more numerous "species" than we apprehend are founded upon adequate natural characters. We wholly agree with Prof. Babington that it is "our business to decide upon the probable distinctness of plants before we attempt to define them;" but we do not agree with him that when defined they should necessarily rank as of specific value, as though nothing of inferior grade were worthy of definition. We believe it would not be for the interest of botanical science to discourage the most careful search after the characteristics of every form from the individual upwards, nor should we object when these characters are common and constant, more or less, to a number of individuals, that they should be referred to in our plant-manuals and described with needful detail, but we do strongly object to the elevation to specific rank of forms which traced over a sufficiently wide area are found to be but local or transitional modifications of a species.* The wholesale manufacture of species, against which we protest, makes a mischief sorely felt in every attempt at philosophical generalization and comparison, especially in the case of comparisons of the vegetation of distant areas. We are willing to grant that Prof. Babington himself, and perhaps some half dozen other British botanists who have made the Brambles their special study for years, might name 50 or 80 per cent. of his so-called species in accordance with the nomenclature of his book, but we confidently defy the best botanists in our country —not Rubologists—to do anything of the kind.

The circumstance that some of these "species" may be identified by independent observers after long study and comparison argues nothing in favour of their specific validity, any more than it would in the case of the entire-leaved form of *Capsella B. pastoris*, which has the advantage that any dunce can recognise it. But this excessive multiplication of specific names is far from being confined to the Brambles, though perhaps they are unfortunate enough to offer the most flagrant instance. Either from a contractedness of view, a want of extended comparison, or from an idea that forms described of subordinate rank to the species are never noticed, some botanists, and Prof. Babington amongst them, have a tendency, whatever group they minutely study, to add to its species. It is curious to contrast with this the course pursued by other botanists, whom we know to have the greatest advantage in respect to the extent of material available for their study, and who feel themselves compelled, the more abundant this may be, to class together as forms of one species what they had previously regarded as distinct specifically. The second genus in Mr. Babington's Manual, *Thalictrum*, has been much abused. Regel, who has recently published a valuable review of the genus and has excellent opportunity for the comparing of the various forms, unites *T. flexuosum*, Bernh., and *T. saxatile*, Schleich., which Mr. Babington holds specifically distinct, under the same variety (*δ. virens*) of *T. minus*, L. The Batrachian *Ranunculi* are in the same predicament, and hardly any of these are identifiable without authentic specimens for comparison. Like many other water plants the old *Ranunculus aquatilis* of Linnaeus is extremely variable, occurring under many forms and varieties. We however question the propriety of uniting with it *R. hederaceus*, as Mr. Bentham has done, who we cannot but think has fallen sometimes, though not often—impelled we may fancy by a sort of righteous horror of species-making—into the opposite extreme of combining forms which might have been reasonably kept distinct. Hooker and Arnott acknowledge, in respect to their six Batrachian *Ranunculi*, that some are maintained in deference to the opinion of other botanists and against their own verdict. Surely these distinguished and veteran botanists ought to have an opinion of their own worth more to them than this. *Fumaria*, *Sagina*, *Cerastium*, *Rosa*, *Pyrus*, *Epilobium*, *Lepigonum* (*Spergularia* of Persoon), *Galium*, *Filago*, *Arctium*, *Hieracium*, *Statice*, *Atriplex*, *Polygonum*, *Juncus*, *Potamogeton*, *Sclerochloa* (a bad genus), *Serrafalcus* (another), and *Triticum*, are some of the other variable genera in which too many species have evolved themselves through the successive editions of Mr. Babington's book.

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* The value of Mr. Bentham's Flora to botanists would have been much enhanced had many more of the forms been alluded to and briefly described under their respective species, which he has sunk as varieties, retaining only the name, or passed over indeed without any mention.

For the convenience of young botanists a dozen or twenty pages may be well devoted to a glossary of the terms used in these Floras, for it is impossible to dispense with technicalities, except at a sacrifice of necessary precision. Prof. Babington, in his last edition of the Manual, notwithstanding his introduction of a tolerably good glossary of nearly 500 terms, has, we observe, made an attempt to substitute ordinary words for technical terms to a great extent, in some cases perhaps with advantage, in others unquestionably with disadvantage. We note amongst the rest blunt substituted for obtuse, burst for dehisce, pitcher-shaped for urceolate, thick for turgid, prominences for papillae, netted for reticulate, stripes for vittae. This last is simply absurd, as it seems to us.

But there are redeeming features in the new edition of the Manual: several important ones. A comparison of the last two editions manifests in almost every page the anxious desire of the author to render his descriptions as faithful and diagnostic as possible. Great pains has been exercised in the revision of these, and the result is worth it. The Latin names have been accented as in Hooker and Arnott; an addition we would commend to the attention of the learned author of the Handbook "for the use of beginners." And the plan of adding the initial letters of England, Scotland, or Ireland, in whichever it may be the plant is found, to each description, has been extended. Hooker and Arnott give more detail as to localities, but at considerable cost of space, which, however, we do not begrudge, although the more general information upon the distribution of each plant, afforded by Mr. Bentham, appears to us better worth it. This forms a marked and most instructive feature in his book, and its tendency we conceive to be wholesome. It would of course be impossible to carry it out in respect to the segregated forms of Mr. Babington, most of which are merely local variations of species as we have already stated. With regard to the introduction of English names on a uniform plan, in correspondence with the Linnean binomial method, by Mr. Bentham, we confess we do not see much advantage in it, and prefer the common names when generally recognized, with their omission when not thus distinguished, to the adoption of the Latin as English, or of uncouthly Anglized names, as Water Catabrose, Red Centranth, Changing Myosote, Ox-tongue Helminth, &c. Opposite Chrysosplene rather shatters the poetry of the favourite Golden Saxifrage.

We cannot conclude this short notice of our Manuals of Descriptive Botany without noting how desirable it is that our observers should direct their attention, more than we believe has been their wont, to the life-phenomena of plants, which have been too greatly neglected by us. Mr. Darwin's late publications on *Primula* and the Orchids are admirable examples, in every way, of the kind of research we have in view; so are the papers of Irmisch and others in the "Botanische Zeitung." Observations of this kind require time, much patience, and close watching, winter as well as summer; but they are just the kind we are in primary need of now. A passage in the last Anniversary Address of the President of the Linnean Society is so *apropos* that we copy it here.—"How little do we know of the real history of the life of those sets of plants upon whose external forms volumes have been published! * * * * We have had enough of splitting of hairs and counting of spots, and of idle controversies as to whether they indicate species, varieties, or individual differences. Let us adopt for the insects and plants of our islands the nomenclature and classification the most convenient for study, and devote our attention to their economy and development, to the complicated structures disclosed by the microscope, and to those innumerable influences which we term accidental, but which appear all to form part of one general plan for the balance of power in the natural world."

It would be a useful addition to our Floras and need not take up much room, were indications scattered through them, under the species which promise to be most inviting, of the relations which still remain obscure concerning them, especially in such matters as the hybernation of perennials and *apparent* impossibility of cross-fertilisation, or of self-fertilisation of flowers.

V.—THE FLORA OF ESSEX; OR, A LIST OF THE FLOWERING PLANTS AND FERNS FOUND IN THE COUNTY OF ESSEX. By George S. Gibson, F.L.S. 1862.

MR. GIBSON is well known as one of the most accurate and conscientious of our working British botanists, and this book of his on the Essex Flora is altogether worthy of his reputation. It appears to have been prepared with great pains in every way, and honest endeavour has been used to render to helpers their due. In accordance with the plan adopted in the best recently-published local Floras, those of Herts and Cambridge, Mr. Gibson divides the county into eight districts, arbitrarily bounded in the absence of available natural divisions, with a view to exhibit the local distribution of species. With regard to this division, when the areas into which the county is to be divided can be arranged to coincide with natural limits, it is desirable, as a rule, to adopt these, since they are frequently approximately coincident with the boundaries of peculiar or characteristic Floras. This is commonly due, however, to more favourable geological conditions, or to greater diversity of surface from elevation or other causes, than obtains in the comparatively tame county of Essex. It is possible at the same time to strain too much in the attempt to obtain natural boundaries for the subdivision of such limited tracts; and we recollect one excellent botanist, afraid to do right through fear of doing wrong, who never could make up his mind about the divisions which he ought to adopt as the basis of his local distribution of species through a couple of counties. It must be borne in mind that different ends may be served by the arbitrary division of the area treated of into tolerably equal parts, and by the adoption of natural divisions equal or unequal. We think, in a very complete local Flora, the area described should, if possible, be treated on both methods. The census of those species indifferent to chemical or mechanical conditions of the soil may be fairly obtained by the arbitrary divisions—apart from the interference of elevation, &c.; while other and often important facts result from comparisons of the vegetation of natural areas, be they ever so unequal in extent. Some years ago, Mr. Baker attempted to classify British species after the plan of Thurmann, with reference to the character of the soil affected by them, and the attempt was praiseworthy and in the right direction, and ought to have been seconded more cordially. Much of the labour expended in collecting what appear to be very barren facts finds now and then unexpected reward, and we look with confidence to the compilers of our local Floras for the material out of which the solution of many important phyto-geographical problems is to be educed. It is impossible to make a local Flora too complete.

In works of this kind devoted to the vegetation of counties and small areas of our own islands, it would be better that the 'species' of the standard work on British plant-distribution—Mr. Watson's 'Cybele'—should be adopted in preference to those of any of our Manuals. It would much facilitate reference and comparison, more especially if Mr. Watson's consecutive numbering (that of the 'London Catalogue of British Plants') were also made use of. In the case of forms, whether 'species' or 'varieties,' subordinate to or included in the species of the 'Cybele,' their local distribution might be readily detailed under the head of their aggregate term. Thus the five *Arctiums* adopted from Mr. Babington would be treated, first, collectively under the Linnean *A. Lappa*, then singly. By the way, what are the cultivation-experiments referred to in the note signed 'N.' (Mr. Newbould), *apropos* of this genus, which tend to show the 'species' to be distinct? One cannot but regret that the results of such delicate experiments should not be more decisive, and, like those of Kirchoff and Bunsen in physics, settle irrevocably specific distinctness. There may, however, be more in them than we anticipate.

Essex contains, according to Mr. Gibson, about 1070 species, native and naturalised, out of the 1725 included in Mr. Babington's 'Manual.' Four are peculiar to the county—viz. *Lathyrus hirsutus* and *L. tuberosus*, *Bupleurum falcatum* and *Galium Vaillantii*. Tolerable figures are given of these species. The *Bupleurum* is regarded as truly indigenous, though confined to one station, where, however, it grows abundantly.

Valuable appendices contain—First. A table showing the date of the first recorded discoverer, the date of the earliest, and also, in many cases, of the most recent, notice of the rarer plants. Second. A list of Essex plants, showing (1) those generally distributed in the county; (2) those more or less local; and (3) the very local. Introduced species are italicised. Third. A tabular comparison of the Flora of Essex with those of Cambridge, Herts, Suffolk and Kent. Fourth. A comparison of the same with Mr. Watson's Table in 'Cybele Britannica,' showing the comparative frequency or rarity of the different British species. Appendix V. contains a list of plants not unlikely to be found in Essex, and another of lost plants which may be refound, eleven in number. Appendix VI. is biographical, with notices of John Ray, the late Edward Forster, and others who have contributed to the Flora of the county.

Original Articles.

VI. — ON THE AMERICAN FOSSIL ELEPHANT OF THE REGIONS BORDERING THE GULF OF MEXICO, (*E. Columbi*, Falc.); WITH GENERAL OBSERVATIONS ON THE LIVING AND EXTINCT SPECIES.

By H. Falconer, M.D., F.R.S., &c. (With Plates I. and II.)

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9. UNITY OR PLURALITY OF SPECIES OF EXISTING INDIAN ELEPHANT.
10. ASSERTED OCCURRENCE OF MASTODON IN AUSTRALIA.
11. FOOD OF LIVING AND EXTINCT ELEPHANTS.
    - (*a*) *Of the Indian Elephant.*
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    - (*c*) *Of the Mammoth.*

§ 1. INTRODUCTORY REMARKS.

MY first knowledge of this form dates from the year 1846, when Sir Charles (then Mr.) Lyell submitted to me, for examination, some fossil mammalian remains, which he had brought with him on his return from his second visit to America.* They formed part of a collection which had been exhumed in 1838-39, in digging the Brunswick Canal, near Darien in Georgia. A selected series of these remains was presented by Mr. Hamilton Couper, the discoverer, to the Academy of Natural Sciences of Philadelphia, where they were identified by Dr. Harlan, some of whose determinations were corrected by Professor Owen, and those of the latter more recently by Dr. Leidy. The locality and the details of the case have been described, first by Mr. Hamilton Couper,† and afterwards from personal observation by Sir Charles Lyell. The specimens brought by the latter included some fragments of the molars of a fossil Elephant, which, after careful examination, I satisfied myself belonged to a species wholly distinct from the prevailing fossil form of North America, namely, *E. primigenius;* my attention having been at the time closely directed to the study of the Proboscidia, fossil and recent. This determination I communicated to Mr. Lyell, who, naturally swayed in his decision by the opinions then prevailing, and his estimate of the turning weight of authority, adopted for the Brunswick Canal form, the name of *E. primigenius,* with the comment, that the species ranged from the Alatamaha in Georgia, to the polar regions, and thence through Siberia to the South of Europe; while I applied to it, in my notes of a systematic classification of the Proboscidia, the designation of *E. Columbi,* after the great discoverer;

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* Second Visit to N. America, 3rd edit. 1855. Vol. i. p. 347.

† Proceedings Geol. Society, 1843. Vol. iv. p. 33.

purposely avoiding a geographical name, which subsequent research, or more extended materials, might prove to be restrictively vicious.

I was fully impressed with the importance of the result, in proving the co-existence of a distinct species of Elephant with the extinct Edentate Fauna of the Southern States of the Union, and as furnishing a probable explanation of the statements made by Humboldt, Cuvier,* Von Meyer, † Blainville, and others, of Elephant remains occurring in Mexico, Texas, and other of the Southern States of North America. Early in the following year I became acquainted with a remarkable series of Elephantine remains, added to the collection of the British Museum, by purchase, in the spring of 1847. They professed to be principally from the vicinity of San Felipe, on the Brazos river in Texas; and I identified a portion of them as being of *E. Columbi*. But I was prevented from following up the subject by my departure to India at the end of 1847, and I reserved it for future research.

Soon after my return to Europe in 1855, Sir Charles Lyell, at my request, placed the Brunswick Canal specimens at my disposal, and I resumed the investigation of the fossil Elephant of the Gulf of Mexico. During the same year, I had an opportunity, on the indication of my friend M. Lartet, of examining, in the Palaeontological Gallery of the Jardin des Plantes at Paris, a small molar referred to by Blainville,‡ as having been brought by M. Le Clerc from Texas, which I determined to be a milk molar of the same form. In 1856 I was enabled, through the courtesy of M. Humbert, to examine, in the Natural History collection of the Musée Académique of Geneva, a series of molars of the same fossil Elephant, brought from Mexico by M. H. de Saussure, a grandson of the celebrated Swiss explorer of the Alps; and by the kindness of my friends Mr. Charles Norton and Mr. Guild of Boston, I was supplied with an excellent cast of the Alabama molar, figured and described by Dr. Warren.§ Early in the following year (1857) I became cognizant of the most perfectly preserved molar of the same form that I have yet seen. It was discovered in Mexico, and presented to the Museum of the College of Surgeons by Mr. Taylor. This specimen, in conjunction with M. Leclerc's milk molar, supplied the means of determining the ridge-formula of the entire set of molars, and of fixing the exact serial position of the form among the Elephants.

The whole of these materials I found to be markedly distinct from *E. primigenius*, and to partake of the characters which are typified in the Georgian molars from the Brunswick Canal. But to place the specific distinction from the Mammoth beyond question, I resorted to the crucial test of sawing up the principal molar of the Brunswick Canal series longitudinally and vertically, in the manner figured in the plates devoted to the Elephants, in the 'Fauna Antiqua Sivalensis,' a procedure which commonly quashes at a glance all doubts as to the specific distinctness, or otherwise, of Elephant molars, in critical cases. The section yielded *colliculi*, showing rather thick plates of enamel folded upon cuneiform cores of ivory, of very considerable width at their base, and separated by correspondingly open interspaces filled with thick masses of cement. These characters were strongly in contrast with the attenuated, parallel, and pectiniform disposition of the materials seen in molar sections of *E. primigenius;* combined with the dilated outline of the 'discs of wear,' and the decided crimping in the plates of enamel, they led me to regard the form as occupying a place in the series between *E. antiquus* and *E. Indicus*, and as differing more from the Mammoth than does the latter from the existing Indian Elephant. These facts were epitomised, but necessarily in a very condensed shape, in the 'Synoptical table of the Species of Mastodon and Elephant,' appended to the memoir which I communicated to the Geological Society on the 8th April, 1857.* In it, *E. (Euelephas) antiquus*, and *E.* (*Eueleph.*) *Namadicus*, respectively Nos. 10 and 11 of the list, are included in the group (*f*) characterized by "*Colliculi approximati, medio leviter dilatati, machæridibus undulatis;*" while *E.* (*Eueleph.*) *Columbi* (No. 12), and *E. Indicus* (No. 13) are included in the next group (*g*), characterized by "*Colliculi approximati machæridibus valde undulatis;*" and for the habitat of *E. Columbi* are given "Mexico, Georgia, Alabama," with a "Post-Pliocene (?) age." Thus, the leading points of the dental characters, and the precise place in the natural series occupied by the species, were distinctly indicated, together with its range of habitat along a stretch of nearly 20° of longitude in the regions bordering the Gulf of Mexico.

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* Oss. Foss. 4to. edit. Tom. i. p. 157.

† Leonhard and Bronn, Neues Jahrbuch 1838, p. 414; *Idem.* 1840, p. 581.

‡ Ostéographie. Éléphants, p. 190.

§ "The Mastodon giganteus of N. America," 1855, p. 162.

In my second memoir, on the same subject, communicated to the Geological Society on the 17th June, 1857, I entered into further details on the fossil Elephant of the Gulf of Mexico, adding that it was found in the fossil state along with species of *Mastodon*, *Mylodon*, *Megatherium*, *Equus*, &c. An epitome of the paper, with these statements, is given in Leonhard and Bronn's 'Jahrbuch' for 1858, p. 379; and the name *E. Columbi*, is adopted by M. Lartet in his important memoir, '*Sur la dentition des proboscidiens fossiles*,'† showing that my determination of the species had not escaped the observation of continental palæontologists.

After the communication of the memoirs above referred to, in which, I believe, the first attempt was made to determine, with precision, the nature of the fossil Elephant of the Gulf of Mexico, I became acquainted with Mr. Bollaert's specimen of an adult lower molar of the same species of fossil Elephant, from the Brazos River in Texas, when it found its way into the British Museum; and the ground having been thus broken, the attention of Palæontologists was speedily attracted to the subject.

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* Quart. Journ. Geol. Soc. Vol. xiii. p. 319.

† "Trois autres proboscidiens ont vécu dans l'Amérique du Nord pendant la "période post-pliocène ou quaternaire ; ce sont *l'Elephas Americanus* que M. Leidy "considère comme étant distinct de *l'E. primigenius; l'E. Columbi*, Falc., des États "du Sud et du Mexique, et le *Mastodon Ohioticus* que quelques auteurs supposent "avoir été contemporain des premiers hommes qui se sont établis dans cette region "du globe." Bullet. Sociét. Géol. de France, 1859. 2e Série, tom. xvi. p. 505.

In September of the following year (1858), Professor Owen, in his Address to the British Association at Leeds, while discoursing on the geographical distribution of animals, made these remarks:—"Geology tells us that at least two species of Elephant formerly did "derive their subsistence, along with the megatheroid beasts, from "that abundant source," (*i. e.* the luxuriant vegetation of tropical America). "Nay, more; at least two other kinds of Elephant (*Mastodon Ohioticus* and *Elephas texianus*) existed in the warm and "temperate parts of North America."* On this occasion, Professor Owen gives no authority for the name *E. texianus*, although then announced for the first time, thus by the established usage in Zoology, producing it as his own.† But in the second edition of "Palæontology," published three years later (1861), in referring to the occurrence of the Mammoth in North America, he adds, "where it existed "not only with the gigantic *Mastodon Ohioticus*, but also with a "second species of true Elephant (*Elephas texianus*, Blake) the teeth "of which were adapted to a succulent vegetable diet."‡ In a foot note to this passage, Bollaert's 'Antiquities of S. America, 2nd Edition,' is cited as the authority for the second species. The author of 'Palæontology,' omits on both occasions to notice that I had previously determined the Elephant of the shores of the Gulf of Mexico, under a different and recognised specific name; and in defence of the new name, he cites authority, the existence of which I have failed to trace. I have ascertained in writing from the publishers (Messrs. Trübner), that no second edition of Mr. Bollaert's work has yet appeared (August, 1862); and on consulting the only impression published in 1860, I have been unable to detect the occurrence of the name even, of *E. texianus*, anywhere throughout the volume, or the name of Blake coupled with any fossil Elephant therein. The sole reference to the Texan Elephant is in a note, professing to be by the author, in which he states, that the Elephant-bones occurring in Texas, are fossil, and well silicified; adding, "I have deposited a grinder in "the British Museum, which appears to be of a new species, see my "Paper on Mastodon Bones in Chile. Geological Soc. Journal. "1857."§

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* Report Brit. Assoc. Leeds, 1858, Address, p. lxxxiv.

† In the Leeds Address, Professor Owen is so scrupulously careful on the score of citation, that he gives in a foot-note, the names of the gentlemen to whom we are indebted for having collected the Purbeck Mammalia. (Address, p. lxxxix).

‡ 'Palæontology,' 2nd. Edit. 8vo. 1861, p. 395.

§ Bollaert 'Antiquarian, Ethnolog. and other Researches in New Granada,' &c. 8vo. 1860, p. 80. There is another statement, contained in a foot-note in 'Palæontology' which demands an observation from me. In the remarks upon *Mastodon*

At length, in November, 1861, Mr. Blake makes his appearance about this fossil Elephant. In a paper 'on the distribution of Mastodon in South America,' the following sentence occurs, in sequence to remarks on the remains of *E. primigenius* in North America: "South of the 30th degree of N. latitude it" (the Mammoth), "however, gives place to a totally different species of true Elephant "(*Elephas Texianus*, Owen, *E. Columbi*, Falconer), the molars of "which by their less degree of complexity were more adapted to "triturate the soft succulent herbage of Texas and Mexico."* Here it will be observed, the name *E. Texianus*, is, with propriety, so far as published evidence goes, attributed to the author, who had four years before become responsible for it. But in February of the

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Arvernensis and *Mastodon longirostris*, the following sentence occurs: "Both belong "to that section of *Mastodon*, in which the first and second true molars have each "four transverse ridges," (Foot-note. "First demonstrated by Kaup, 'Ossemens "'Fossiles de Darmstadt, 4to. 1835,') "and for which Dr. Falconer proposes the "name *Tetralophodon*." (Op. cit. 2nd. edit. p. 387.) I challenge the production from the work cited, of any passage containing the demonstration asserted in the note; it is certainly nowhere to be found there: even the word *section*, or any other equivalent term, expressive of the idea of a subdivision of the genus into groups does not occur in it, and for the simple reason, that published materials to suggest it, did not at the time exist. I was the first to generalise on the subject, and establish the constancy of the *ternary* and *quaternary* ridge-formulæ in the Mastodons as a means of ranging all the known species, under the two natural groups of *Trilophodon* and *Tetralophodon*; I further extended the same principle of the ridge-formula, to the arrangement of the rest of the Proboscidian forms, or Elephants, under the divisions of *Stegodon*, *Loxodon*, and *Euelephas*. Until then, the species were in extreme confusion; and nowhere was this more signally evinced than in the writings of Professor Owen on the family. Kaup, with characteristic fairness, recognises the fact, in reference to the *Mastodons*. In proof, I refer to his 'Beitraege,' 3. Heft. (1857) pp. 1, 19. What Kaup vehemently claims as his special discovery, is, that he was the first to show the precise number of molar teeth, that succeed each other from back to front in *Mastodon* (excluding premolars, *i. e.* vertical successors); and that his observation on that genus, furnished the cue for determining the same series in the Elephants. The 'Ossemens Fossiles de Darmstadt,' is freely quoted in the 'Odontography' and in the 'British Fossil Mammalia,' both published ten years later; yet it is not a little singular, that the demonstration asserted in the note, did not prevent Professor Owen from confounding, under the common designation of *Mastodon angustidens*, the dentitition of three distinct species of *Mastodon*, one of them belonging to the section *Trilophodon*, and two to the section *Tetralophodon*. Further, in the same work, 'Palæontology,' Sismonda's figure of the Astesan *Mastodon*, is reproduced, as the principal illustration of the genus, under the misnomer of *M. Turicensis*, and described as having *ternary-ridged* molars, like *M. Ohioticus*, notwithstanding that Sismonda,§ confirmed by myself after a detailed examination, figures and describes it as *quaternary*-ridged: *M. Turicensis*, (a synonym of *M. Tapiroides* of the French palæontologists) being a *miocene* species of the Dinotherian type, and the Astesan *Mastodon*, (*M Arvernensis*) a *pliocene* species of another type. These and other like errors, which I could adduce, are brought out in a work professing to be an exposition of the science at the present day. But with reference to the 'Bollaert' and 'Kaup' citations here challenged, it is necessary to direct attention to the reprehensible practice of citing known works for matter, the existence of which cannot be traced in them.

§ 'Osteographia di un Mastodonte Augustidente.' Turin, 1851. 4to. p. 23, line 10. Pl. I. fig 2.

* Geologist, 1861. Vol. iv. p. 470.

present year, another paper appeared in the same periodical, entitled, 'On a fossil Elephant from Texas (*E. Texianus*),' by Mr. Blake, who now stands sponsor for that specific designation himself, *E. Columbi* being quoted as a synonym.* It is a nice point to decide to whom the credit of the new name should be awarded. Professor Owen, at first produces it as his own, and then, after a long interval, assigns it to Mr. Blake: while conversely, the latter, in the first instance, unguardedly attributes it to Professor Owen, and then takes it to himself. There is jactitation of the name between the two naturalists, with hesitation and self-denial on both sides; but it is clear that it is a joint production; and there is a consistent harmony of ideas and expression in their reasoning regarding the succulent food of the fossil species. Indeed, the only difference which I can detect, is, that Professor Owen introduces the name with a small initial, and Mr. Blake with a capital; by the canons of nomenclature the younger naturalist has the advantage of his senior. But the usage of science does not countenance such accommodating arrangements, when the result is to prejudice a prior right.

Let us now see what intrinsic claims the *Elephas Texianus* of Messrs. Owen and Blake has upon the recognition of paleontologists, Mr. Blake being their exponent;—

"As the British Association, in their rules for Zoological Nomen-" clature, have authoritatively sanctioned the principle that names " not clearly defined, and likely to propagate important errors, may " be changed, and as the name of *E. Columbi* lays itself open to the " grave charge, that it is not clear, whether it is named in honour of " Columbus, or because it is found in Columbia (Venezuela y Nueva " Granada), I trust that this name will not be accepted. That of " *E. Texianus*, founded upon a yet unimpeached geographical dis-" tinction, if it has not the advantage of published priority, yet gives " a more lucid idea of the nature of the species which it indicates.

"The figure by Mr. Mackie gives a better idea of its appearance " than any mere verbal description. I however define it as Elephas " Texianus, *dentium molarium* (M. 6.) *Colliculi undulati, magis* " *remoti quam in E. Indico.* Its association with *E. Indicus* and " *Armeniacus*, by Dr. Falconer, seems warranted by its legitimate " affinities." (Op. cit. p. 58.)

In reply to the first point, the author must permit me to remark that the supposed 'important error' and 'grave charge' are only the results of imperfect knowledge and inexperience. The derivation of *E. Columbi* is so obvious, that nothing I can say could make it plainer. No educated naturalist could apply the term to the geographical region of Columbia, without giving it an adjective form, or supplementing the last vowel with an important terminal diphthong, the requirements of the case being inexorable. Putting aside the fact that Columbia was nowhere in question as a habitat of the species, the British Association has not legislated against Latin grammar.

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* Op. cit. 1862. Vol. v. p. 57.

As regards the force of the claim, put forward in the second clause,—every terrestrial mammal must have a regional habitat somewhere; but I fail to apprehend how the proposed geographical name would convey 'a more lucid idea of the nature of the species.' In natural history, the distinctive characters of species are commonly founded on something more intrinsic and tangible. Further, four years before, I indicated that the fossil species had ranged from Georgia to Mexico, a stretch of nearly 20° of longitude. To restrict it to the intermediate region of Texas would be a step of retrograde error.

In the proposed specific definition, I fail to detect a single term or character which is not either expressed, embodied, or implied, in my Synoptical table above referred to; with this difference, however, that the author has mal-adroitly handled terms of which he knew the meaning but imperfectly. The *colliculi*, or constituent ridges of the unworn teeth, are not undulated; but the enamel plates of these ridges are crimped, and their worn edges in the abraded molar, display the character by their '*machærides undulatæ*.'

On these grounds, I cannot acquiesce in the ingenuously avowed aspiration, that the law of priority should in this case give way, in order that *E. Texianus* of Owen and Blake might supplant the earlier name of *E. Columbi*. The reasons assigned for the proposed change are so light and trivial, that I should not have considered it necessary to notice them, but for the fact that the paper is accompanied by an illustration of the Bollaert-Molar; for a figure of a new or imperfectly known form, will always carry with it a citation of the name it bears, and of the paper in which it occurs, however slight the latter may be.

§ 2. DENTITION OF *E. Columbi*.

I shall now examine the principal remains of *E. Columbi* that have come under my observation.

Of the milk-dentition, the only specimen which I have seen is a penultimate milk-molar (m. m. 3.) *in situ* in a finely preserved left ramus of the lower jaw of a very young Elephant, contained in the Palæontological Gallery of the Jardin des Plantes, and labelled (No. 77), as having been brought by M. LeClerc from Texas. It attracted the attention of Blainville (who figured and described it in the dental series of *E. primigenius*) as presenting unusual characters:—

"Le troisième echantillon est plus intéressant, d'abord à cause de "son origin, puisqu'il vient du Texas d'ou il nous a été rapporté par "M. LeClerc, et ensuite parce qu'il semble indiquer quelque chose de "particulier."* In this young molar, the anterior ridge, together with the front talon, are broken off, the remaining part of the crown being composed of seven ridges and a slight posterior talon. These ridges are quite intact, and much more apart, than in *E. primigenius*, agreeing in this respect with *E. Indicus*. The digitations are well marked at the apex, forming distinct points, and in the last ridge their separation can be traced to a depth of nearly an inch, a condition which ordinarily involves a high degree of crimping of the enamel-plates. The crown is narrow in front, and widens so abruptly behind, as to have suggested to De Blainville the term '*subdidyme*' to characterize it; he describes it as resembling most the analogous tooth of the existing African Elephant. This peculiarity is best expressed by the dimensions, viz., length of crown 2.7 inches, width in front at the second ridge 1.1 inches, width behind 1.7; the length being to the extreme width in the ratio of about 3 : 2. The empty alveolus of the last milk-molar (m. m. 4) is distinctly visible in M. Le Clerc's specimen. The penultimate milk-molar thus yields, for its term in the ridge-formula, 8 colliculi besides talons. The specimen, so far as mineral condition is concerned, is well fossilized, like those from the Sewalik Hills, and the "Forest bed" of the Norfolk coast, being hard, heavy, and weathered, and not adherent to the tongue.

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* Ostéographic Éléphants, p. 190, pl. x. fig. ii. c.

The specimen next to be noticed, is a detached and very finely preserved antepenultimate true molar (m. 1) of the lower jaw left side, No. 741*a* of the additions to the Cat. of Foss. Mamm. of the Royal College of Surgeons. It is a comparatively late acquisition (since 1855), and was brought from Mexico by Mr. Taylor. The crown and body of the tooth are quite perfect from end to end; the fangs are mostly broken off, but a portion of them still remains. The crown is composed of twelve colliculi, with front and hind talons. Of these the eight anterior divisions are worn, the rest being intact. The discs of wear are wide and open, wider than in the ordinary varieties of the existing Indian Elephant, and nearly approaching the width commonly presented by *E. antiquus*. But they differ from those of the latter species, in showing no angular expansion in the middle of the discs, and no outlying loop at the angles. In this respect they correspond more with the discs of the existing Indian Elephant. The edges (*machærides*) of the enamel-plates are highly crimped with numerous close-set flexures; in this respect also maintaining a resemblance to the Indian Elephant, and differing from *E. antiquus*. Notwithstanding the distinctions here indicated, the aspect of the crown in the Mexican molar, bears a striking general resemblance to that of typical specimens of the same age of *E. antiquus*, the most obvious difference being, that the crown in the former is much wider in proportion to the length, than in the latter, in which the molars have narrow crowns, like those of the African Elephant. The specimen is represented by fig. 1 of Pl. II.

A notable peculiarity in the Mexican tooth is, that the body of the molar is very much bowed sidewise, *i. e.* concave on the outer side and convex on the inner. The amount of arcuation is much greater than I remember to have seen in any other species of

Elephant, fossil or recent, in molars of corresponding age, viz., adolescent. Something of the same kind is seen in Mr. Bollaert's specimen, as figured in the 'Geologist': but in this case, in a minor degree, in consequence of the anterior third of the crown having been worn away. I believe that this peculiarity in the lower molars of *E. Columbi* is a constant character of the species, and that it bears a relation to the converging form of the rami of the jaw, to be noticed in the sequel.

The dimensions of the Mexican molar are:

Length of crown	7.4 inch.
Width of ditto in front	2.3 „
Greatest ditto	2.5 „
Height of ditto at 8th ridge	4.3 „
Space occupied by the 8 anterior discs	4.3 „

It is hardly necessary to remark that the characters of the molar above described, differ entirely from those of the common form of the Mammoth of North America.

Von Meyer, in the 'Neues Jahrbuch' for 1840,* briefly notices some fossil remains of *Mastodon* and *Elephant*, contained in the Mexican collection of Herr Uhde. Among these are an upper and lower molar, of a fossil Elephant, in which the enamel-plates were wider apart than in *E. primigenius*, in this respect having a closer resemblance to those of *E. proboletes* of Fischer de Waldheim, which Lartet conjecturally refers to *E. meridionalis*. The description would agree with that of *E. Columbi*, from the same region.

Sir Charles Lyell's Georgian specimen, from the Brunswick Canal, upon which my first knowledge of *E. Columbi* was founded, consists of the middle portion of the penultimate or last true molar, probably the latter (m. 3) lower jaw right side, broken off, both at the anterior and posterior ends. The fragment comprises ten complete ridges, with part of two others, of which the anterior seven are more or less worn. All the fangs are broken off, together with the basal mass of ivory. The summit of the crown is concave from back to front, and the tooth is also concave with a little torsion on the outside, and convex inwards, showing that it was considerably arcuated laterally, like the specimen last described. The discs of wear are of moderate width, as in the Indian Elephant, with a tendency in some of them to expansion in the middle. This is most pronounced in the second, where the expansion nearly attains half an inch. The plates of enamel are thicker than in the Mammoth, and about equal to those of the Indian Elephant; they present a considerable amount of parallel shallow plaiting, which is prominently shown where they rise above the level of the cement. The wear of the crown takes place in a succession of steps, from the front backwards, which it is of importance to notice with reference to the inferred food of the species. These steps rise like a flight of stairs, each being composed of the whole mass of cement of one of the valleys, and the combined enamel plates and ivory of the ridge immediately behind it. There are five of these steps in the Georgian specimen, the posterior ridges being intact.

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* Leonhard and Bronn's 'Jahrbuch,' 1840. p. 581.

The dimensions are as follow:

Length of crown measured at the base	9.5	inch.
Ditto ditto at summit of crown	6.9	,,
Width of crown in front	3.2	,,
Ditto at 4th remaining ridge	3.5	,,
Ditto behind at widest part	3.3	,,
Height of ditto at 8th plate where unworn	6.2	,,
Ditto of anterior worn plate	2.5	,,

Pl. I. represents a longitudinal section of the specimen, by which the specific distinction from the Mammoth is best shown. The plates converge from the convex base to the summit irregularly, but somewhat like the *voussoirs* of an arch; so that the same number of plates, diminishes from 9.5 inches at the base to about 7 at the crown. The ridges are not so high as in the Mammoth, and their constituent elements, *i. e.* the enamel, ivory, and cement are thicker. In the interval between the 10th and 11th ridges, the cement attains, near the base, the excessive thickness of six-tenths of an inch, being about twice as much as what is ordinarily seen in the section of the Mammoth. For the contrasted difference, I refer to the sections, pl. I. fig. 1, of the 'Fauna Antiqua Sivalensis.'

The specimen next to be noticed is No. 33,218 of the MSS. register, British Museum, Palæont. Gallery. It was acquired of Mr. Bollaert, and it bears a record of having been procured from San Felipe de Austin, on the Brazos river, in Texas. It is figured in the 'Geologist.'* This superb morceau consists of the posterior three-fourths of the last true molar, lower jaw, left side, well advanced in wear. The crown presents the remains of the posterior fourteen ridges and hind talon; the anterior portion had been ground down by use, and has disappeared. The two anterior ridges are worn to the base, and confluent in a common depression of ivory, upon which a slight islet of enamel remains. Of the succeeding ridges, the next seven are worn down into transverse discs, which are open, and bounded by highly crimped and thick plates of enamel, bearing a close resemblance in this respect to the corresponding teeth of the existing Indian Elephant. Some of the plates show a considerable amount of undulation in the general sweep of the *machærides*, but there is no tendency to the mesial expansion, or outlying loop, seen in *E. antiquus*. The five posterior ridges are all more or less affected by wear; the most of them present distinct annular discs on the tips of the digitations, which are seen to be of large size, as in *E. planifrons* and *E. meridionalis.* The eighth ridge shows these annular discs semi-confluent into a transverse depression. The ninth presents five worn digitations; the tenth and eleventh six, and the twelfth five. There is no mark of pressure behind, proving the tooth to be the last of the molar series. The space occupied jointly by the first six distinct transverse discs, amounts to 5.4 inches, giving an average of nine-tenths of an inch to each ridge. This is considerably greater than that shown by the crown of the Georgian molar, but it is to be borne in mind that the difference is accounted for by the teeth being in different stages of wear.

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* Vol. 5. p. 57, Pl. IV.

The principal dimensions are:

Extreme length of crown . . .	12.5	inch.
Width of ditto at first transverse disc .	3.0	„
Ditto at fifth ditto	3.7	„
Ditto at eighth ditto	3.8	„
Ditto at ninth ditto	3.1	„
Height of crown at ninth ditto where highest	5.4	„
Space in length occupied by the six anterior distinct discs of wear . . .	5.4	„

Making allowance for the part of the tooth borne upon the anterior fangs, which has been worn away, the entire molar must have been of very large size; and it indicates a species that attained colossal dimensions.

Other illustrations of *E. Columbi*, are furnished by a collection of fossil bones, part of which was purchased for the British Museum in 1847. They are stated to have been found by Mr. W. Huff on the banks of the Brazos River, near San Felipe de Austin in Texas. One of the specimens, a fine Bovine skull, (*Bison latifrons*, Leidy), is identifiable with a figure given by Dr. W. M. Carpenter, of New Orleans, who published the first account of these remains. Among them were numerous fragments of bones, said to have been of Elephant and Mastodon; the teeth of Elephants, especially, predominating. A proboscidian tusk measured eleven feet in length, and twenty-six inches in girth at the base; but no details are given regarding the molars of Elephas.* In the series, belonging to the National Collection, reputed to be of this origin, (Nos. 20,701-5 MSS. Register) is a superb specimen (No. 20,702) of a last molar of the lower jaw right side, comprising the posterior three-fourths of the crown in fine preservation, the anterior part having been lost by a vertical fracture. Fifteen ridges are presented together with a talon-ridge. Of these, thirteen are more or less worn, the seven anterior into continuous transverse discs, which, measured along the surface of the crown, occupy a length of 4.6 inch. The two next (8th and 9th), are divided towards the outer side by a wide fissure into two unequal flattened elliptical discs; the 10th yields three discs, the 11th four, and the 12th five thick annular depressions. The rest are nearly intact, and present from four to five very thick digitations. The enamel-plates of the seven anterior bands, present irregular secondary wavy curves, but they are free, or nearly so, from crimping. In this respect, and in being perceptibly thinner, they differ considerably from the other Texan lower molar, No. 33,218 above described. Regarded sidewise, the ridges look very thick and massive, and they are retrofracted about half way up, by an abrupt flexure, somewhat like the Pourentrui molar figured by Blainville, (Elephants, p. 199, Pl. X fig. V*a*).

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* Silliman's Journal, 1846, 2nd Series, Vol. I. p. 245.

The principal dimensions are:

Length of space occupied by 13 worn ridges	8.5	inch.
Ditto „ by 7 anterior ditto	4.6	„
Width of crown in front . . .	3.4	„
Ditto in middle	4.6	„
Ditto greatest	4.8	„
Greatest height of crown . . .	7.2	„

The dimensions above, yield an average of about .7 inch to the seven anterior discs, and .65 to the series of thirteen, being considerably less than in No. 33.218. The latter, also, in the thickness and undulation of the enamel-plates, resembles more the existing Indian Elephant. Although crimping is absent from the fossil under description, the great thickness of the ridges, and the limited number and massiveness of the digitations, remove it from *E. primigenius*, in which the digitations are slender, and double the number. The width of the crown is enormous, being nearly 5 inches, agreeing in this respect with the Alabama molar to be noticed in the sequel. Although with some doubt, I refer the specimen to *E. Columbi.* It is well fossilized and adheres strongly to the tongue.

Another specimen, of the same series, (No. 20,702), is a fragment comprising the posterior two-thirds of a left lower penultimate, (m. 2.), and including eleven ridges, the talon being wanting. Of these the anterior six are partly worn, but none of them into transverse discs; the first three, are in three divisions, each forming a flattened ellipse; the enamel is thick, but does not show any considerable amount of crimping. The ridge-plates are nearly vertical, and the intact digitations of the hinder ones are thick. The crown is well coated with cement.

The following are the dimensions:

Length of fragment . . .	7.8	inch.
Width in front, at middle of plate . .	3.4	„
Height where intact at 7th ridge . .	5.7	„

The above dimensions yield an average of .7 inch to each ridge. The specimen agrees very closely, in every respect, with the corresponding molar of the Indian Elephant, and with the characters of the lower molar No. 33,218.

There are other Elephant molars in the Texan series, which belong to a different species, to be noticed in the sequel.

The late Dr. Warren, in his excellent monograph on the 'Mastodon of North America,' has figured three specimens, selected by him as representing the principal varieties of fossil Elephant, occurring in the United States. One of these, of which I possess a cast, (op. citat. pl. xxviii. A. p. 162.) is the Alabama tooth, stated to have been found in the neighbourhood of the Gulf of Mexico. It consists of the middle portion of an enormous last upper molar, right side, well advanced in wear; the anterior part supported on the large front fang, had been ground down by use, and the posterior third wanting. The fragment exhibits eight complete ridges and the half of a ninth in front. Of these, three anterior are worn into continuous transverse discs which are open, but without mesial expansion. They bear a close resemblance in general contour and in the sweep of the secondary curves of the enamel-plates to those of the Bollaert molar described above, as figured in the 'Geologist.' It is difficult to measure the amount of crimping on these plates from a cast. Dr. Warren describes the enamel-edge as slightly undulating; but his figure represents them to be distinctly and closely festooned as in the molars of the existing Indian Elephant. The fourth ridge has the digital terminations semi-confluent into the three distinct discs; the fifth into four; while the three last ridges are nearly intact. The digitations of the latter are very thick, and do not exceed four or five in number, while commonly, in *E. primigenius*, they are slender and numerous. In illustration of the difference, I may refer to pl. xxviii. C. of Dr. Warren's work, representing a huge upper molar of *E. primigenius* from Zanesville, in Ohio, in which the corresponding ridges exhibit the ringed tips of ten slender digitations. The cement filling the valleys is partly removed by decay and denuded on the sides of the crown, in the Alabama tooth, so that the character is somewhat disguised; but the discs of wear appear to rise in successive steps as described above of the Darien molar; bearing in mind that the one is an upper and the other a lower molar.

The following are the principal dimensions supplied by the cast:—

Length of the molar measured at base .	7.0
Do. of the 8 posterior ridges at base of crown	6.6
Width of crown at 3rd ridge . .	4.6
Greatest do. behind . . .	4.9*
Height of the last ridge (intact) . .	8.0

The above dimensions give an average of eight-tenths of an inch as the thickness of the ridges, a proportion which, I believe, is never attained in the true Mammoth. With the reserve dictated by the defects of a cast, and balancing all the characters, I am led to regard the Alabama molar as being of *E. Columbi*. Dr. Warren appears to have considered it as an extreme variety of *E. primigenius*.

The only other dental remains of this species which I have seen were some mutilated specimens of adult molars in the Musée Académique of Geneva. They were brought from Mexico, by M. H. de Saussure. No account of them, so far as I am aware, has as yet been brought out; and the notes which I took were of a general character, without entering on details. They agreed, in all their leading characters, with the Georgian form from the Brunswick Canal in presenting comparatively broad ridges, separated by wider intervals than in the Indian Elephant, but attaining less elevation than in the latter; the enamel plates well crimped, and the discs of wear open. They impressed me, at the time, as being distinct alike from the Indian Elephant and from *E. antiquus*, and still more distinct from the Mammoth. The same collection contained the cast of a magnificent specimen of an adult lower jaw of *Mastodon Andium*, invested with a very massive and elongated incisive beak, deflected downwards, and retaining the basal section of one very large incisor. The original was stated to have been found near Tlascala, and it appears to be the adult mandibule of the same form, which yielded the younger specimen figured and described by Laurillard in d'Orbigny's Voyage.

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* Dr. Warren states the length to be seven and the width four and a half inches. The cast may give a line or so of excess; but the crown with its coat of cement must have exceeded 5 inches in width.

The materials above described, supply only two entire teeth, both being of the lower jaw, *i.e.* a penultimate milk-molar (m. m. 3), from Texas, and an antepenultimate true molar (m. 1) from Mexico, the former showing eight ridges, and the latter twelve; but as these two agree in the number of their ridges with the corresponding tooth of the Indian Elephant and Mammoth, and as they exhibit the same series of progressive increments, the complete ridge-formula is inferred to have been thus: —

$$\overbrace{\frac{4,\quad 8,\quad 12,}{4,\quad 8,\quad 12,}}^{\text{Milk Molars.}} : \overbrace{\frac{12,\quad 16,\quad 20\text{—?}}{12,\quad 16,\quad 20\text{—?}}}^{\text{True Molars.}}$$

The last true molars, above and below, commonly present from twenty-two to twenty-four ridges in the Indian Elephant and Mammoth. It remains to be seen, whether, taking into account the greater thickness of these ridges in *E. Columbi*, they ever exceeded twenty in that species.

The species clearly belonged to the group *Euelephas*, and in so far as the dental characters go, its nearest affinity was with the existing Indian Elephant, occupying a position in the series between it and *E. antiquus*. It differs from the latter by the absence of the constant mesial and sub-angular expansion of the discs of wear, common to it in a minor, and to the African Elephant in a major degree. The difference from the Indian Elephant is less considerable, consisting chiefly in the enamel-plates being less strongly crimped, and in the discs of wear being more open. Judging from the triturating characters of the molars, so far as the analogy of the living species will help us, the food of *E. Columbi* was probably like that of the Indian species, consisting of branches, twigs, and leaves of certain trees, with reedy grasses, and other similar vegetable matters.

To my apprehension, they do not indicate succulent matters (*i. e.* in the botanical sense of the word) to have been the staple food of the species, as conjectured by Messrs. Owen and Blake, nor anything less ligneous than the aliment of the Indian Elephant. The grounds of this opinion will appear fully in the sequel, in discussing the general bearings of the question with reference to the food of other fossil Elephants.

Of the cranium and other bones of the skeleton, nothing is at present known, although it is probable that abundant remains exist in the North American and Mexican collections. Silliman's Journal for 1838 contains an account of some elephant-bones, discovered in Jackson County, Ohio.* Among these was a lower jaw, of which a rude sketch is given, along with that of *E. primigenius.* The rami are represented as converging to a pointed chin, and a very contracted symphysial gutter; totally different from the broad rounded chin, and wide gutter which are constant in *E. primigenius.* In both respects, the figure agrees more with the mandibular form presented by *E. Indicus*, and *E. antiquus.* The bowed Mexican molar, above described, would suggest that the mandibule of *E. Columbi* was of a similar form. But the figure of the Elephant of Jackson County is too imperfect to be reliable for more than a conjecture. The figure, in the same plate, of a detached molar, represents a crown, resembling that of the Mammoth. The anonymous author of the communication provisionally names the form *E. Jacksoni*, but that this means nothing more than to serve the occasion, is implied by the fact that he names the existing species, compared with it, as *E. recens*, *i.e.* the Indian Elephant.

The 'Huff Collection' from Texas, in the British Museum, includes (No. 20,705) a right ramus of the lower jaw, which presents the outer shell of the bone entire, from the posterior edge of the ascending ramus, to the symphysis; but the inner side broken off vertically along the middle of the alveolus, the whole of the inner wall of which is removed, together with the molar contained in it, and the beak of the mentum is broken off. Being so mutilated, it is impossible to say to what species it belonged. But the diastemal edge of the symphysis slopes gently forwards, and with much less vertical abruptness than is characteristic of the mandibule of *E. primigenius.* It is therefore not unlikely that the specimen belongs to *E. Columbi.*

Apart from the very numerous instances, recorded in the American Journals, of the occurrence of Elephant-remains in most of the United States, and commonly attributed to the Mammoth, there are two cases bearing upon *E. Columbi* which require special notice.

The first from the same reputed Texan series, in the National Collection, is an enormous fragment of a cranium, composed of the right maxillary, part of the malar, and the right half of the palate, containing a stupendous last true molar (m. 3), *in situ*, in fine preservation. The posterior half of the alveolus is wanting, leaving a great part of the tooth exposed. The anterior part of the crown, borne on the large front fang, had been ground away, but its presence is distinctly indicated by the fang pit of the inner division, in front of the tooth. What remains of it is composed of twenty ridge-plates, with a single talon-digitation appended behind. The anterior fourteen or fifteen are more or less worn, the hinder ones being intact. The general plane of the worn surface is quite flat, as is usual in Mammoth-molars, and is free from any tendency to the terraced steps seen on the crown of *E. Columbi*. The discs of wear form narrow closely compressed bands, transverse and straight, with no medial expansion. The enamel-plates are thin, and as a general rule unplaited, although some of them, as in the fifth ridge, exhibit a certain amount of fine crimping. The enamel-edges (*machærides*) rise but very little in relief above the ivory and cement. The ridge-plates are vertical, and enormously high, the fourteenth, which in the germ was not the highest, measuring between 10.5 and 11 inches. The five hinder plates fall off very rapidly in height. The crown is very broad, being but a line or two short of five inches.

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* Silliman's American Journ. 1838, vol. xxxiv. p. 347, *et seq.* "On Mather's Report on the Geological Survey of Ohio."

The following are the principal dimensions:—

Length of crown measured by a tape, over the summit from base of talon to anterior fang-pit . .	18.25 in.
Ditto from hind talon to anterior fang, straight by callipers	14.2 ,,
Width of crown in front	3.4 ,,
Ditto at middle of ninth ridge . . .	5.0 ,,
Ditto behind	3.5 ,,
Height of fourteenth ridge	10.7 ,,

The ridges are so condensed that the joint length of the posterior twelve, having worn discs, amounts only to 6.7 inches, being an average of about half an inch to each. The Alabama tooth and this Texan molar agree in being of very large size; but they differ throughout in the detail of distinctive characters. I can detect nothing by which the latter can be distinguished from *E. primigenius*. It is of a colossal size. The substance of the bone and tooth is iron-shot, and the matrix is a coarse ferruginous gritty sand, mixed with fine gravel.

The second case is more remarkable and important, being that of the fossil Elephant of the Pliocene Fauna of Niobrara, an affluent of the Missouri River in Nebraska, the account of which, by Dr. Leidy, has excited much interest and surprise among Palæontologists.* According to that distinguished naturalist, this extinct Fauna has already yielded 3 distinct *Canidæ;* 3 distinct *Felidæ;* 2 *Rodents;* 8 *Ruminants*, the majority of them new; 8 *Equidæ*, belonging to six genera or sub-genera; 1 large Rhinoceros (*R. crassus*, Leid.) "which "appears to have had almost the same size and formula of dentition "as the recent Indian Rhinoceros, *R. Indicus;*" 1 Mastodon of the sub-genus *Tetralophodon*, *M. mirificus*, Leidy, and a huge Elephant, *E.* (*Eueleph.*) *imperator*, Leidy. The published descriptive details of this Elephant are as yet but very meagre. One specimen only is mentioned, being the anterior portion of an upper molar, of larger dimensions than any known to the author. The crown is stated to be "within a line or two of five inches in breadth, and within a space "of seven inches, only eight enamel folds or double plates exist." This would give an average of nearly nine-tenths of an inch to each ridge, corresponding closely with the proportions yielded by *E. Columbi.* The ridges are described as becoming worn into transverse strongly crenulated ellipses. Dr. Leidy adds, "that the fragment of the tooth has been assumed to belong to an unnamed "species, from the fact that it was found in association in a fauna "very distinct from any previously noticed."*

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* Proceed. Acad. Nat. Scien. Philadelp., 1858, p. 20, *et seq.*

§ 3. RANGE OF HABITAT AND GEOLOGICAL POSITION OF *E. Columbi.*

The precise localities where remains of the species occur in Mexico, and the conditions under which they are met with, are but imperfectly known. The best authenticated site is the 'Barranca of Regla' near Real del Monte, 60 miles north of the city of Mexico. It is stated in Silliman's Journal, that in that region, they are found in some places in beds overlaid by lava.† The fragments of Elephant-molars communicated by Humboldt to Cuvier, are said to have been found at Hue-huetoca, in the valley, and not far from the city of Mexico.‡ Cuvier describes the remains from Huehuetoca, as detached plates of very large molars, compressed, and with the enamel attenuated and barely crimped, as in the Siberian Mammoth. Von Meyer states, that the remains brought to Europe by Herr Uhde, were met with, partly, in the valley of Toluca, near the Hacienda of *Salceda*, about 9000 feet above the level of the sea; partly near the ancient pyramid of *Wilcox*, on the Chilco-Lake, at 7500 feet above the sea, and some others on the hills of *Chapultepec*, about 100 feet above the level of Mexico.§ M. H. Saussure, in a communication, with which he has very courteously favoured me, mentions, that the remains of the fossil Elephant, which he brought from Mexico, were met with in the deposits of Puebla, and on the slopes of *Tacubaya*, in the valley of Mexico (antea p. 44); and that the Mastodon remains occurred, some of them near *Xalapa*, others at *Atonilco el grande*, near Real del Monte, and the great mandibule with the elongated beak (antea

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* *Idem.* p. 29.

† Silliman's American Journ. of Scien. 2nd Ser. 1858, p. 283.

‡ Cuvier. Oss. Foss. 4to. tom. i. p. 157.

§ Leonhard and Bronn's Jahrbuch, 1840, p. 581.

p. 56) near *Tlascala*. In reference to the stratigraphical nature of the deposits, he adds: "Je crois que tous les terrains du plateau, "composés d'argiles et de cinerites contiennent les mêmes espèces. "Ce sont des amas de dejections volcaniques melées par les eaux qui "ont rempli les basfonds. Ils ont une puissance de plus de 100 "pieds." The remains which have been observed in Texas were discovered on the banks of the Brazos and Colorado Rivers, at San Felipe, Bastrop, &c. in the prairie-deposits.* Cases of the occurrence of Elephant-remains in the valley of the Mississippi, in the States of Louisiana, Arkansas, and Mississippi have been recorded, but not in sufficient detail to determine the species. Dr. Warren mentions, that he possessed thirty molars of the fossil Elephant of Alabama, but he gives no details regarding the conditions under which they were found.† All the circumstances connected with the remains occurring in Georgia have been carefully investigated by able observers. Between the Apalachian Mountains and the Atlantic there is a wide stretch of horizontal tertiary strata, forming three terraces, each about twenty miles wide.‡ The lowermost, or littoral platform, rises from ten to forty feet above the level of the sea, and stretches at least 400 miles northward to Newbern on the Neuse in Carolina. The deposit is fluvio-marine, resting upon Eocene strata: although mainly marine, it contains beds of freshwater origin, in which the Mammalian remains occur. Lyell considers it to be very analogous to the great Pampean formation of South America, as described by Darwin, and to be of Pleistocene age. The bones were found between four and six feet below the surface, imbedded in clay, resting on yellow sand, and belonged to *Megatherium*, *Mastodon*, *Elephant*, &c. The ascertained range of *E. Columbi*, from Mexico to Georgia, includes 18° of Long. and 12° of Lat. between the parallels of 20° and 32°. But there are grounds for suspecting that it ranged into South America. M. Lartet has recorded the fragment of an Elephant's molar, characterised by thick ridge-plates, brought from Cayenne in French Guiana by Captain Perret, and presented by him to the museum of Marseilles.§ What makes this not improbable, is the fact, that Dr. le Conte while in Honduras, examined the Mastodon-bed near the village of Tambla, in one of the passes, leading from the plain of Comayagua to the Pacific, and satisfied himself that the species found there was identical with *M. giganteus*, (*Ohioticus*) of North America.‖ It is therefore not unlikely, that the fossil Elephant of Georgia, may have ranged still further south than Mexico, into Guiana.

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* Bollaert. Journ. R. Geograph. Soc. Vol. xx. 1850, p. 115-117.

† On Mastodon giganteus, p. 62.

‡ Hamilton Couper. Geol. Proceeds. 1843, Vol. 4, p. 33; and Lyell's Second Visit to North America, 3 edit. 1855. Vol. 1, p. 347.

§ Bullet. Soc. Geol. de France, 2d Ser. tom. xvi. p. 500.

‖ Proceed. Acad. Nat. Scien. of Philad. 1858, p. 7.

§ 4. Associated Fossil Mammalia.

Of the Mexican Mammal cotemporaries of *E. Columbi*, but very little has as yet been ascertained. Von Meyer, in his notice of Herr Uhde's collection, mentions a Mastodon, resembling *M. angustidens* of Kepfnach in Switzerland; a phalangeal bone of a Pachyderm, bearing some resemblance to that of the genus *Rhinoceros;* and upper and lower molars presenting the characters of the existing genus *Equus*.* The collection formed by M. H. de Saussure, included *Mastodon Andium*, as distinguished by the French Paleontologists from *M. Humboldtii*. In Texas,† as already stated, *E. Columbi* was found along with remains of *Tapirus Americanus* (Leidy), *Bison latifrons* (Leidy), a species of *Mastodon* not named; bones supposed to be of a species of *Mylodon*, and probably also a colossal form of *E. primigenius*.

The Georgian remains from the Brunswick Canal have been severely examined by different paleontologists. Among them, besides Elephant, there were *Megatherium mirabile* (Leidy), *Mylodon Harlani* (Ow.), *Mastodon Ohioticus*, *Bison latifrons* (Leid.), *Equus Americanus* (Leid.),‡ together with bones of a large Chelonian, *Chelonia Couperi* (Harlan). It was supposed, at the time of their discovery, that the Darien fossil Fauna, included *Hippopotamus* and *Sus*; § of these the former was negatived by Prof. Owen, and the tusk fragment upon which it was founded referred to Mastodon, while the latter has passed through many phases of nomenclature. First named *Sus Americana* by Harlan (loc. cit.), it was then regarded by Prof. Owen as the type of a new genus intermediate to *Lophiodon* and *Toxodon*, which he first described under the designation of *Lophiodon bathygnathus*,‖ and afterwards as *Harlanus Americanus*; ¶ but the specimen upon which the opinion rested has been satisfactorily determined by Leidy to be nothing more than a lower jaw of his *Bison latifrons*.** At Skiddaway Island on the Atlantic shore, near Savannah, the same genera and species have been met with; and Dr. Leidy mentions the association, on the shores of the Ashley River in South Carolina,†† of remains of the same *Megatherium*, with those of *Elephas*, *Mastodon*, *Equus*, *Tapirus*, *Dicotyles*, *Hipparion*, *Hydrochœrus*, &c.‡‡ On all occasions, until lately, where this Elephant has been named, in the American memoirs, it has been cited as *E. primigenius*. Generalising approximatively, as far as the ascertained data will admit, it would appear that where fossil Elephants occur in the States east of the Mississippi, those found to the north of the Apalachians, belong chiefly to *E. primigenius;* and that *E. Columbi* is the predominant, although not the sole species, in the littoral States south of the chain, as far north as Newbern near Cape Hattras. Huge extinct Edentata accompany both; but Dr. Leidy has found no authentic evidence of *Megatherium* having ranged beyond the maritime portion of Georgia and South Carolina. *Mylodon Harlani* is said to occur north and south of the chain.

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* Leonhard and Bronn's 'Jahrbuch,' 1840, p. 581.

† W. B. Carpenter. Silliman's Journal, 1846. 2nd Ser. Vol. 1, p. 245.

‡ Leidy. Extinct Sloth Tribe of North America, 1855, p. 54.

§ Harlan in Silliman's Journal, Vol. xliii. 1842, p. 143.

‖ Cat. Foss. Mammal. &c. Mus. Coll. of Surg. p. 197.

¶ Proceed. Acad. Nat. Scien. Philadelph. Vol. iii. 1846, p. 94.

** Proceed. Acad. Nat. Scien. Philad. 1854. vii. p. 89.

†† "Extinct Sloth Tribe, &c." p. 51.

‡‡ Leidy Op. cit. p. 58.

Knowing, as we do, what an important feature the large extinct Edentata constitute in the Newer Pliocene fauna of the littoral regions both of North and South America and of the interior of the United States, it is not a little remarkable, that, neither in the Lower Miocene Fauna of Nebraska, nor in the Pliocene Fauna of Niobrara, both of which have been so ably investigated by Leidy, has a single Edentate form been discovered, although in the latter, as already mentioned, both an Elephant and Mastodon occur.* The great number of Equine forms found in the Niobrara deposit, coupled with the antiquity of some of the genera to which they have been referred (*e. g. Anchitherum*) is equally remarkable, and suggestive of reflexion, with reference to some of the great problems which now occupy naturalists, regarding the derivation and spread of species, and the former continuity of continents which are now severed by wide oceans.

Of two asserted facts, which it was of the utmost importance to determine with accuracy, one appears to have been clearly established: namely, that the extinct Edentate and Proboscidian Fauna of the United States, existed long after the deposition of the northern drift. This was put beyond doubt by Lyell many years ago; the bones of *Mastodon Ohioticus*, which are commonly associated with *E. primigenius*, were found along with existing shells in Tennessee in a swamp "in a cavity of the boulder formation, so that the animal must have "sunk after the period of the drift, when a shallow pond fed by "springs, was inhabited by the same species of freshwater mollusca "as now live on the spot." The same result was arrived at in the fresh-water deposit on the right bank of the Niagara, near the Falls. The drift between Lakes Erie and Ontario was inferred to be of much higher antiquity than the gravel containing the bones of Mastodon at the Falls.†

But the evidence in support of the inference that the same extinct Fauna existed before the deposition of the 'drift,' in the same region, is not equally conclusive. It has been asserted that Dr. W. M. Dickeson discovered in Mississippi, east of Natchez, remains of *Megalonyx*, *Mylodon*, *Mastodon*, *Equus Americanus* (Leid.), *Bootherium*,

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[*] Proceed. Acad. Nat. Scien. Philad. 1858, p. 20, *et seq.*

[†] Proceed. Geol. Soc. 1843, Vol. 4, p. 36. These results have been confirmed by the later observations of Professor Ramsay. Quartly. Journ. Geol. Soc. 1859, Vol. xv. p. 214.

Cervus, *Ursus*, *Tapirus*, &c. " in a tenacious blue clay which underlies the diluvial drift."* The precise determination of the geological age of the deposit in this instance, is of the very highest importance, since, at a depth of about two feet below the skeletons of *Megalonyx* and other extinct genera, it yielded, according to Dr. Dickeson, the greater part of an *Os innominatum*, which was identified as being of an adolescent human subject, and which proved to be strictly in the same fossil state as regards colour, density, and mineral condition, as the bones of *Megalonyx* and the other associated animals. Had both the asserted facts been satisfactorily established, the antiquity of the human race would have been carried back in America to a period, infinitely more remote than has anywhere as yet been claimed for it, through recent investigations, in Europe. But the term '*diluvial drift*' appears to have been used, in this instance, in the vague comprehensive sense in which it was generally applied by geologists, before the labours of Prestwich, Godwin-Austen, and other observers, had discriminated the relations of the true 'glacial drift' from those of the Valley Gravels and Loess deposits. I am informed by Sir Charles Lyell, that the bed of material overlying the 'blue clay' at Natchez, is of the nature of a Loess or Lehm deposit, and that the clay itself is probably of a more modern date than the 'true drift.' A shade of suspicion has been cast on the identification of the fossil itself, as having been derived from a human subject, by a remark made by Dr. Leidy, who has examined and identified the associated remains.† Other instances have been appealed to, in proof of the Probiscidian and Edentate fauna having preceded the 'drift' in the United States; but in no case as yet, has the evidence been as conclusive as it can be shown to be, with regard to the Mammoth in Europe.

§ 5. SYNONYMY OF AMERICAN FOSSIL ELEPHANTS.

The Elephant molars, occurring so abundantly along with *Mastodon Ohioticus* in the United States, have, since the time of Cuvier, been almost universally referred to *E. primigenius*. But an impression existed among palæontologists in America that there might be distinct species. Dr. Warren, in 1855, expresses it thus: " We still " remain without any decisive fact calculated to determine whether " the American varieties differ specifically from the European, and " whether these varieties differ specifically from each other."‡ In 1852,

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* Proceed. Acad. Nat. Scien. Philadelph. 1846, Vol. iii. p. 107, and Leidy, op. cit. p. 6,

† " With these specimens, and presenting the same general appearance of colour, " compactness, &c., was discovered the *so-called* fossil human innominate bone." (Leidy, 'Extinct Sloth Tribe,' p. 6.) The authenticity of the specimen and of the identification is strongly maintained in Morton's 'Types of Mankind,' by Nott and Gliddon, p. 343. Sir Charles Lyell no longer doubts the authenticity of the bone as contemporaneous with the associated remains.

‡ On 'Mastodon Giganteus,' p. 161. Agassiz, at the Cambridge (U. S.) meeting of the American Assoc. for the Advancement of Science, 1849, described the molar and tusk of an Elephant, found in Vermont in digging the Rutland and

Leidy, in the introduction to the "Fossil Fauna of Nebraska,"* designates the fossil Elephant of North America *E. Americanus*, as distinct from *E. primigenius*. But he gives no diagnostic characters, and assigns no reason for the change, which appears to be founded mainly on the supposed improbability of the same species having ranged from Europe to America. His *E. imperator*, he assumes to be distinct, "because it was found in association in a Fauna very distinct from any previously noticed," (antea, p. 59.) He separates the *Megatherium* of North from that of South America, avowedly on these grounds; and it would appear that he distinguishes his *Equus fraternus* and *E. complicatus*, from the European forms called *E. primigenius*, and *E. plicidens*, on the same principle.† But the practice is open to grave objections. It assumes a difference on theoretical grounds, where the direct evidence, so far as it goes, indicates the contrary; and its general adoption would tend to arrest, on the threshold, the investigation of the means through which remote geographical forms, presenting common characters, may have started from a common origin.

The separation of some of the American Pleistocene Horses and Bisons, from the European fossil species, may prove, on the comparison of sufficient materials, to be well founded. But as regards the true Mammoth, *E. primigenius*, exclusive of *E. Columbi*, I am satisfied that it rests on no sufficient grounds. The well known characters, upon which Cuvier established his definition of the species, have been confirmed by the general observation of Palæontologists up to the present day, namely: the cranium long, with a concave forehead, and very elongated tusk-sheaths; the lower jaw rounded, with a rudimentary beak; the molar teeth very broad relatively to their lengths, and the constituent layers of ivory, enamel, and cement, very thin and condensed. The definition was so good, in consequence of its including so many elements of undoubted authenticity, presented together in the same individuals. But entire skulls are very rare, and it is only under favourable circumstances, that entire mandibules are met with; while the dense, hard, and more durable molars occur everywhere. Practically, therefore, the identification of the species, in most instances, rests upon them: and the characters which they yield are so constant and well marked, that with care on the part of the observer, they are perfectly reliable, and sufficient for the purpose. In the London collections, taking those of the British Museum and College of Surgeons together, abundant materials exist for the comparison of molars of the American Mammoth with those of the Siberian and European forms. The Hunterian collection contains a fine series

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Burlington Railway, and said to have been from below the Erratic boulder drift, which *from recollection* he believed to be different from the European Mammoth, p. 100.

[*] Op cit. p. 9.

[†] Proceed. Acad Nat. Scien. of Philadelphia, 1858, p. 11.

of palates with teeth, lower jaws, and detached molars of the Mammoth, from different localities in the United States. The vast collection in the British Museum includes numerous remains of the species from Eschscholtz-Bay and Siberia, accessible for ready comparison with British specimens. They all present, in the main, the same characters: a uniform ridge-formula; the same obtuse form of the lower jaw, and the same broad crowned molars, composed of closely compressed colliculi, with numerous digitations and attenuated uncrimped enamel-plates. The space within which the present communication is necessarily limited, prohibits my entering into the details of the comparison. One of the most essential points, is to determine the constancy of the ridge-formula, which, after the examination of a very large quantity of materials, I believe in the Mammoth to be thus:

$$\frac{\overbrace{4,\ \ 8,\ \ 12,}^{\text{Milk molars.}}}{4,\ \ 8,\ \ 12,} : \frac{\overbrace{12,\ \ 16,\ \ 24.}^{\text{True molars.}}}{12,\ \ 16,\ \ 24.}$$

the consecutive ciphers indicating above and below, the number of colliculi which normally enter into the composition of the antepenultimate, penultimate, and last milk-molars in the first groups, and in the second, those of the three true molars. The plates advance by quaternary increments in each series, bearing in mind, that the first true molar, although of larger dimensions, commonly repeats the number of ridges presented by the last milk-molar, and that the last true molar in all the Elephants and Mastodons is more composite than the others.* The formula in the North American Mammoth is identical with that of the Siberian and European forms. Exceptions are occasionally met, in which an unusual number of plates is presented. For instance, Dr. Warren figures and describes a last upper molar from Ohio, in which, including talons, the tooth presents thirty-two ridges.† But *Mastodon Ohioticus*, in which the dental characters

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* I take this opportunity of indicating a correction in the 'ridge-formula' of the subgeneric group *Euelephas*, given in my memoir "On the Species of Mastodon and Elephant," contained in Vol. xiii. of the Quarterly Journal of the Geol. Society, 1857, p. 315. Instead of the cyphers

$$\frac{\overbrace{4,\ 8,\ 12,}}{4,\ 8,\ 12,} : \frac{\overbrace{14,\ 18,\ 24,}}{14,\ 18,\ 24-27,}$$

the series should have been:

$$\frac{\overbrace{4,\ 8,\ 12,}^{\text{Milk molars.}}}{4,\ 8,\ 12,} : \frac{\overbrace{12,\ 16,\ 24,}^{\text{True molars.}}}{12,\ 16,\ 24-27.}$$

The correction, it will be observed, applies solely to the ciphers above and below, characteristic of the *antepenultimate* and *penultimate* true molars, the discrimination of which always presents the greatest difficulties.

† On 'Mastodon giganteus,' p. 163, Pl. xxviii. fig. c.

are very constant, occasionally exhibits a similar numerical excess in the ridges in the last true molar.*

There is one peculiarity, however, in the molars of the North American Mammoth, which is so constant, that I believe in most instances, by means of it, they can be discriminated in a mixed collection of European, Asiatic, and American specimens, namely, that the ridges, and their constituent elements, are more attenuated and condensed. For example, in the Museum of the College of Surgeons, there is a palate-specimen (No. 620 of Cat.) containing the antepenultimate true molar, an either side perfect but well worn. On the left side the tooth measures 5 inches long by 2.7 wide, and presents the discs of 14 ridges, inclusive of the two talons, being an average of but .36 in. to each. A superb specimen of a last upper, in the Hunterian collection from Ohio, presented by Dr. Casper Winter, (No. 615 Cat.) exhibits 17 discs of wear in a length of 7.7 inches, giving an average of .46 to each ridge; while a last upper molar from Siberia, presented by Dr. Rogerson, gives an average of .54 for each ridge. Taken singly, the difference seems inconsiderable, but when uniformly repeated over a length of crown comprising sixteen or twenty-four ridges, it is perceptible at a glance, and gives a certain amount of distinctive physiognomy to the molars of the North American Mammoth. The same character is seen in specimens from Eschscholtz-Bay, *e. g.*, in a palate (No. 24,585) Paleont. Gallery, British Museum. But I do not regard it as indicating more than a slight geographical variety, as the other characters, such as the form of the lower jaw, &c. remain constant to the true Mammoth-type.

It has been asserted, that the kind of molar upon which *E. meridionalis* is founded, occurs not only in England, but as far north as Eschscholtz-Bay in Arctic America; and the figures given by Buckland, in the voyage of the 'Blossom,' are cited in illustration.† But the assertion has arisen from a hasty and superficial examination of the specimens. The ivory-cores of the ridges in the Elephants, are wedge-shaped bodies, broader at the base and thinning upwards. The plane of abrasion intersects these wedges obliquely, so that, when far advanced in wear, the discs of the same ridges are much wider below, than the width of their base, and than they were in an earlier stage at the apex. The Eschscholtz-bay molar referred to, is a last true molar, so far advanced in wear, that little more than the posterior half of it remains in the lower jaw. In front, part is worn down to the base, thus yielding the dilated appearance which has been mistaken for the character of *E. meridionalis*. The mandibule which contains it, is preserved in the British Museum, exhibiting all the typical characters of *E. primigenius*. When the materials are in a tolerably fair state of preservation, I have hardly ever seen a case, where a molar of *E. meridionalis*, or of *E. antiquus*, could be confounded with that of the Mammoth. Mutilated and fragmentary specimens are frequently puzzling; simply because they are *torsos* of the worst description, in which parts are not merely wanting, but what remains is disfigured and disguised by abrasion.

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* On 'Mastodon giganteus,' p. 79.

† British Foss. Mamm. p. 238.

In the view here taken, there are, at the present time, but two well-determined species of fossil Elephant known in North America.

1. *E. primigenius*, Blumb. Syn. *E. Americanus*, Leidy. The name *Rupertianus*,* of Sir John Richardson, might have been cited as another synomym, but for the fact that that distinguished naturalist and Arctic explorer, with characteristic frankness, withdrew it, as soon as he became aware, by his own later researches, that it was untenable.

2. *E. Columbi*, 1857, Syn. *E. primigenius*, *pro parte*, of the American Palæontologists; *E. Texianus*, Owen, 1858.

Whether the Cayenne specimen spoken of by Lartet (antea, p. 60) belongs to this, or to a distinct species, remains to be ascertained.

The same, with our present knowledge, must be said of the *E. imperator* of Leidy, from Niobrara. Until a perfect molar is figured and described, no satisfactory opinion can be formed as to what the species is. Dr. Leidy, as already stated, assumed it to be distinct, and gave it the name upon the assumption.

The same uncertainty applies to the specimens described conventionally by the anonymous author, for the occasion, under the name of *E. Jacksoni*. (antea, p. 57). The detached molar, by the figure, agrees with *E. primigenius*, while the lower jaw, so far as the figure can be trusted, indicates a different apecies.

§ 6. RANGE IN TIME OF THE MAMMOTH.

The geographical range of the species has been established from Texas across the continent of North America to Eschscholtz-Bay, thence from Arctic Siberia, across the steppes of Russia, through Germany, France, and England, to central Italy in the neighbourhood of Rome. I carefully examined the collections at Naples, including that of the University, where every facility was afforded to me by Professor Scacchi, and that of Signor Costa, but failed to detect a trace of it there, or in Sicily, in the Museums of Syracuse, Catania, Messina, or Palermo, the last of which contains a very considerable number of molars and other remains of fossil Elephants. There is clear evidence of the true Mammoth having existed in America long after the period of the Northern Drift, when the surface of the country had settled down into its present form. It becomes a question of the highest interest and importance to ascertain the first appearance of the species in time. The data, for its solution, are still so limited and imperfect, that the most we can do is to indicate where it is earliest met with, as a starting point for future observation. That the Mammoth existed in Europe long after its emergence from under the sea of the Northern Drift, has been clearly established by more than one class of evidence. Abundant remains of the species have been observed in the 'high' and 'low level gravels' of river valleys in France and England, the nature and origin of which have been so ably investigated by Prestwich and other observers; these valleys having been excavated, either during, or after, the rise of the drift-covered land, but mainly after it, when the country was inhabited by the Mammoth, *Rhinoceros tichorhinus*, &c., during the decline of the Glacial period. In the Apennine valley of the Chiana in Tuscany, *E. primigenius* existed so late as to have been a cotemporary of the Irish Elk (*Cervus euryceros*), *Bos primigenius*, and *Bison priscus*, bringing down the period to the very modern date of the superficial marly beds of the Isle of Man. The proofs of this assertion will be given more in detail in the sequel. Setting aside the cave evidence, on which I have dilated elsewhere, there is a specimen of a last lower molar, left side of a Mammoth, in the Natural History Museum of Torquay, presented by Mr. C. E. Parker, which, Mr. Pengelly informed me, was dredged up in Torbay, at no great distance from the shore, and probably came out of the well known submerged 'peat' or 'forest bed' of that inlet. It is exceedingly fresh-looking, with a slight tinge of smut, as if it had lain in a peat-bed, and the surface is entirely free from any incrustation of marine Polyzoa, with which it must have got covered, had it lain long at the bottom of the sea. This peat-bed indicates a subsidence of the land in Devonshire, then peopled with Elephants, of a very modern date, and long subsequent to the period of the raised-beach, which is so boldly developed along that part of the coast.

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* 'Zoology of the Voyage of the Herald,' p. 102.

For a long time I was led to question the occurrence of the true Mammoth in England, anterior to the deposition of the 'Boulder-Clay,' in consequence of the questionable nature of the evidence upon which the asserted instances rested. They had either not been observed *in situ*, or were patched over with recent Polyzoa, showing that they had been dredged up from the bottom of the sea. But I have lately seen abundant proof of indisputable authenticity in the collections of the Rev. John Gunn of Irstead, and the Rev. S. W. King of Saxlingham, both in Norfolk, besides other cases, that *E. primigenius* of the characteristic type existed in England before the deposition of the Boulder-Clay. Perfect molars, presenting every element for rigorous identification, have been found in the 'Forest-bed' at the bottom of the section, between Cromer and Happisburgh, on a horizon of fluviatile or lacustrine strata, which have yielded remains of *E. meridionalis*, *E. antiquus*, *Rhinoceros Etruscus*, and *Hippopotamus major*, &c. But not a trace of Mammoth has as yet been discovered in the 'Norwich' or in the 'Suffolk crag.' The submergence of the land of the 'Forest-bed,' under the sea, is defined with the utmost precision; the true Mammoth existed in England long before it, or at any rate during the gradual refrigeration which preceded that event.

In the supplement to Sir Charles Lyell's 5th edition of the Manual of Geology (1857), it was stated on my authority "that there "is no well authenticated example of this species" (*E. primigenius*) "having ever been met with South of the Alps. The specimens "from Monte Mario, and other localities near Rome, belong, according to him (Dr. F.) to *E. antiquus*, Falc., and *E. meridionalis*, Nesti, "and those in Piedmont and Lombardy to the same two species, "together with *Elephas priscus*." But this opinion was negatived in 1858, by the fact that M. Lartet, whose verdict is of the highest authority in all that relates to the Proboscidia, identified an unquestionable specimen of *E. primigenius*, received from Professor Ponzi, by whom it was discovered *in situ*, in the volcanic gravel-deposit of Monte Sacro.* On visiting Rome in the spring of 1859, I saw abundant proofs of the accuracy of M. Lartet's correction, in the rich private collections of Professor Ponzi, and Signor Ceselli, in the University Museum of La Sapienza, and Kircher's collection in the Jesuits' College. The authenticity of the localities was placed beyond question, by the volcanic matrix of the specimens, showing crystals of *Pyroxene* and nodules of decomposed *Leucite*. As this is a point of weighty importance in reference to the geographical range of *E. primigenius*, it may be well to adduce some instances of the evidence in support of it. The first is a fragment in the collection of Signor Ceselli, comprising the anterior two-thirds of an unworn penultimate upper molar, presenting nine collines, very attenuated and closely compacted, seven of them being presented within the space of 3.2 inches, giving an average of about .46 inch to each. The enamel very thin, and the digital terminations slender and numerous, there being about nine to each colline. This specimen is undistinguishable in its character from a Mammoth's tooth of the same age from Siberia, or an English gravel-bed. It was found in the volcanic gravel-bed of *Ponte Molle*, and the matrix abounds in Pyroxene and Leucite. Another is a specimen presenting the anterior half of a penultimate lower left true molar, with ten ridges, all more or less worn, within a space of 4.5 inches, yielding an average of .45 inch to each. The typical characters of *E. primigenius* are most distinctly shown in the thin transverse attenuated plates of enamel, free from any tendency to crimping. The matrix is of a fine greyish-yellow sand, full of grains of pyroxene. It was found on *Monte Sacro*, near *Ponte Nomentano*, and is preserved in the museum of La Sapienza. The same collection contains several other specimens of the same form, of which I find detailed descriptions in my notes. But the great mass of the Elephant-molars contained in the collections of Professor Ponzi and Signor Ceselli, and in the Roman museums generally, belong to *Elephas antiquus*, which occurs alike in the older pliocene deposits of Rignano, and in the volcanic gravels of the Campagna. Here, therefore, we have unquestionable evidence that *E. primigenius* inhabited Central Italy, when the extinct Latian volcanoes were in full action. There are no data for correlating with precision this epoch with that of the Norfolk 'Forest-bed,' but it reaches as far back, nearly, as the close of the Pliocene period.

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* Bullet. Sociét. Géologique de France, 2e série, tom. xv. p. 565.

On the other hand, in the Alpine valley of the Chiana in Tuscany, I met with decisive evidence that *E. primigenius* had survived in Italy down to a comparatively modern period. The museum of Arezzo contains a mutilated cranium of this species, presenting all the basilar portion, from the occipital condyles on to the incisive bones, both the maxillary bones, together with the palate, and the two last true molars *in situ,* on either side, of an old animal. The specimen exhibits the most typical characters of the Mammoth, throughout. The same collection includes lower jaws, detached molars, an entire humerus, and a radius and ulna of the same form. Some of these remains were very fresh-looking in colour, although adhesive to the tongue. Along with them, in the same turbary deposit, were found eight frontal fragments with the horn cores of *Bos primigenius* and three of *Bison priscus;* and in the University Museum of Bologna, I saw an undoubted skull of *Cervus euryceros* (the Irish Elk), from the same localities in Val di Chiana. It is worthy of remark, that in no one of the Italian museums, from Naples to Turin, did I detect a trace of *Rhinoceros tichorhinus*, although with an eye specially directed in search of it. I carefully examined Monti's lower jaw, referred to by Cuvier as being of that species,* and I can affirm, with confidence, that it belongs to another extinct form. It is preserved in the museum of Bologna. With the exception of *R. tichorhinus*, the fossil fauna of the Val di Chiana exhibits all the leading forms of the large Ungulata that accompanied the Mammoth in the north of Europe, before its final extinction.

Passing over the superficial deposits of Central and Northern Europe, I shall refer briefly to the Mammoth-deposits of Siberia and the Ural mountains. The nature of the accumulations of the bones of Elephants and other northern quadrupeds at the mouths of the Siberian rivers is so well known, through the writings of Pallas, and other naturalists and travellers since his time, that it is only necessary to allude to one leading fact, namely, that besides the freshness of condition in which they are preserved, the Siberian Fauna, as a whole, agrees with that of the 'low-level gravels' of the river valleys and 'superficial drift' of the last stage of the Glacial period in Central Europe, and that it has not yet been shown to contain any of the older extinct species, like the *Elephas antiquus*, *Rhinoceros mega-*

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* Oss. Fossiles, 4to. tom. ii. p. 73. Tab. ix. fig, 10. Prof. Capellini obligingly gave every facility for the examination of the specimen, by removing the enveloping matrix.

rhinus, or *Hippopotamus major*, which are found along with the early form of the Mammoth, in the pre-glacial 'forest-bed' of the Norfolk coast, or in the volcanic gravels around Rome.

The authors of the 'Geology of Russia' have, in their great work, investigated with much ability, the nature and origin of the auriferous gravels in which Mammoth bones occur, on the flanks of the Ural mountains. They infer that the species had existed for a long course of ages upon the adjoining high lands, when the low region now skirting the Polar Sea was submerged; that the vast quantities of fossil bones found near the mouth of these rivers, are the result of the secular accumulation, during a long period, of carcasses floated by floods from the highlands into the great estuaries; and that the last elevations of the Urals, which led to the production of gold veins, were probably the chief causes that conduced to the final destruction of the Mammoth in Siberia.* But the leading general fact, observed with regard to the Siberian fossil Fauna, holds equally good of that of the auriferous gravel-deposits, of local origin, on the flanks of the Urals: *Elephas primigenius*, *Rhinoceros tichorhinus*, *Bison priscus*, *Equus*, &c., are the prevailing forms. Not an instance has been adduced of the older associates of the Mammoth, above-mentioned, having been found among these remains. *E. primigenius* has become extinct in the swamps of North America, and in the valley of the Tiber, where auriferous gravels, and Ural upheavements, had no share in producing the effect. The disappearance of the species must be sought for in causes of a more general scope.

M. Lartet, in his very able and suggestive essay 'On the Ancient Migration' of the existing Mammiferous Fauna of Europe,† takes the inference of these authors as his starting point, and carries it further than appears to have been intended by them. He avers that the remains of *E. primigenius* and *Rhinoceros tichorhinus*, have nowhere, in Europe, been discovered, except in deposits of a more modern age than the Northern drift; and that these species did not make their appearance among us, until *after* the emergence of the drift-covered plains of western Russia, at the close of the Glacial period; in short, that the Fauna was first, *tertiary*, in the north of Asia, and then became *quaternary* in Europe. But this very ingenious argument, is at once negatived by the fact, that we have unquestionable evidence, that the Mammoth existed in England before the deposition of the 'Boulder-clay,' as the cotemporary of Mammalian species, handed down from the Pliocene period.

On a review of the data which we possess, at the present time, it would appear, that there is not a tittle of proof, that *E. primigenius* has been met with anywhere in Europe or Asia, in deposits of an older date than the 'Forest-bed' of the Norfolk coast. The Mammoth is emphatically entitled to the significant name proposed by Geoffrey St. Hilaire, in one of the bright inspirations of his latter years, of '*Dicyclotherium*,' as having by a 'miracle of Providence,' survived through two epochs.* The geographical range of its associate *Rhinoceros tichorhinus*, was greatly more restricted. It has never been observed in America, nor as yet in Italy. The same restriction appears to apply to its range in time; I have seen nothing as yet, to satisfy me, that it existed in the Fauna of the 'Forest-bed' of Norfolk. The negative evidence, in a case of this kind, is of little value, since it proves nothing more than the limit of our positive knowledge up to a given time; but the asserted instances of its occurrence,† are regarded by me as erroneous identifications, and as belonging to a more ancient extinct species.

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* 'Geology of Russia in Europe,' &c. p. 492, *et seq.*

† Comptes Rendus, tom. xlvi. Seance 22, Fevrier 1858.

§ 7. EARLIEST HEAD-QUARTERS OF THE MAMMOTH—WHERE?

Another question comes up for discussion. On what ancient land was the first dwelling-place of the Mammoth? Whence did it radiate through the vast geographical area included within its ascertained range of habitat? The prevailing impression, at the present time, appears to be in favour of the high land of northern Asia. But I know not upon what good grounds it can be sustained. That the species existed there in great force, during a long lapse of time, has been clearly established; and it seems equally clear, that it spread from that area into America, by Behring's Straits or the Aleutian Isles, before the severance of the two continents took place, surviving, in North America, down to a date that would correspond with the superficial lacustrine marls and ancient peat-bogs of Europe. But the cast of the North Asiatic fauna, as shown above, is so entirely modern, as to have been regarded by Lartet, as being that of the ancestors of our existing European mammalia. The sub-Uralian deposits have, as yet, supplied no consistent evidence of Pliocene strata, or Pliocene mammalia, by means of which, the Mammoth-yielding and auriferous gravels may be synchronized with, or differentiated from, the newer Pliocene strata of England, in which the Mammoth occurs, along with species of an older age. At present there is a wide gap, in the formations other than marine, between the Miocene strata along the shores of the Black Sea, which, at Nicolajew in the Chersonese, near Odessa, have yielded the greater portion of the skeleton of a *Mastodon Tapiroides*,‡ and the Ural gravels containing bones of *E. primigenius* and its usual associates.

But there are strong grounds to suspect that Pliocene deposits exist on the western flanks of the Ural mountains, the geological history of which still remains to be unfolded. Pallas, in his 'Observatio de dentibus molaribus ignoti animalis, &c., ad Uralense jugum repertis,'[*] which Lartet refers to *M. Borsoni*,'[†] distinctly states that the two molars were found in a horizontal stratum of indurated sandy and ochreous iron-ore which is worked on the bank of the Schebysy, an affluent of the Bjelaya, on the western slope of the Urals. The Vergennes and Abbé Chappe molars, figured by Buffon in the 'Notes Justificatives,' appended to 'Les Epoques de la Nature,' the former procured from '*Little Tartary*,' and the latter reputed to be from Siberia (or the Crimea?), confirm the statement of Pallas, both being of *M. Borsoni;* and Lartet tells us that he had identified with certainty, as of *E. meridionalis*, the fragment of a molar lately received by M. Ravergie, from St. Petersburg, adding that the specimen is encrusted with the same ferruginous, sandy, and ochreous matrix, as described by Pallas.[‡] *M. Borsoni* is a constant Pliocene species; occurring in Italy in the same Sub-apennine beds which yield *E. meridionalis;* in France below them; and according to Pallas, in Russia, in beds at a lower level than those which yield the Mammoth. The evidence, therefore, slight and imperfectly defined though it be, gives the forecast of the same order of succession upon the slopes of the Urals as in Europe, namely, subaerial beds, containing remains of the Pliocene mammals of Italy, and above them Mammoth yielding deposits of the age of the Glacial period.

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* Op. cit. Séance, 23 Janv. 1837.

† Brit. Foss. Mam. pp. 347 and 364.

‡ Quart. Jour. Geol. Soc. Vol. xviii. (Translations, &c.) p. 13.

It is now well ascertained that after the Miocene period, great alterations in the relation of land to sea took place in the regions stretching eastward from the shores of the Black Sea, beyond the Caspian and the Lake of Aral. We have also undoubted evidence that the true Elephantine Proboscidea, exclusive of numerous species of *Stegodon* and *Mastodon*, existed in India during the Miocene period. The same fossil fauna has been traced from Burma, north along the foot of the Himalayahs to the frontier of Affghanistan, and thence southward, along the Sooliman range to the promontory bounding the estuary of the Indus to the West. But from this point westward to the shores of the Black Sea, and from the Hindoo-Koosh to the Caucasus, the entire region, including Persia, Arabia, Toorkistan, Armenia, and Asia Minor, is almost wholly unexplored, so far as the extinct mammalia of the Pliocene and Quaternary periods are concerned. Is it not probable that when this vast tract is better known, the fossil Elephants of Europe and Northern Asia may be traced back towards their Miocene head-quarters in India? Where the ground has been broken, facts of much interest have been yielded. During the Crimean war, Colonel J. M. Giels, in passing through the province of Erzeroom in Armenia, discovered, close to a village called Sharvoon, near Khanoos, some remnants of a fossil Elephant which he presented to the British Museum. Major R. Jones Garden, F.G.S., being soon after on a tour in Asia Minor, and having courteously offered his services, proceeded at my request to the locality, to make further explorations. The remains indicated that the skeleton of the animal had lain in the cliff of a ravine, about twenty-five feet in height, the section consisting of alternate beds of clay and fluviatile sand, the latter charged with fragments of *Dreissena*. The bones were in a very friable condition, and the skull crushed and decomposed; but Major Garden was able to exhume some portions of tusks six-and-a-half inches in diameter, which in desiccation crumbled to pieces. The specimens presented by Colonel Giels to the national collection, consist of two last upper molars in fine preservation, and a portion of a lower, all apparently of the same individual. These molars strike a practised eye, at the first glance, as presenting something intermediate between the Mammoth and the existing Indian Elephant. The case is of so much interest, that I shall venture on some of the details. The left upper molar (m. 3, being No. 32,250 Museum Regist. Palæont. Gallery) is entire from behind the large front fang, the portion borne upon which had been ground down by protracted wear.* The anterior part of the crown to the extent of 2.7 inches is also worn out, presenting merely a smooth surface of ivory, behind which there are seventeen ridges and a posterior talon. Of these, fifteen are more or less worn. The anterior nine form transverse narrow discs; the next six are divided nearly equally by two rather wide longitudinal channels into three divisions, consisting each of a flattened elliptical disc. The transverse discs, in their general character, bear a close resemblance to those of the Indian Elephant, the enamel-plates being rather thick, with very pronounced close-set crimping in the middle, but diminishing towards the cornua. These discs are narrower than is commonly seen in the existing species, less open and less parallel across. The crown is broad, and the enamel plates are high. To render these descriptive details more appreciable and available for comparison, I append the principal dimensions:—

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[*] 'Acta Pretropolitana,' 3d Ser., 1777, tom i. p. 213, tab. ix. fig. 4.
[†] Bullet. Societ. Géol. de France, 2e Ser. tom xvi. p. 484.
[‡] Op. cit. pp. 500 and 516.

Extreme length of crown	11.75
Length of crown surface in use (partly worn out)	9.5
Space occupied by the anterior ten discs measured at top of crown	5.7
Ditto ditto, at base of crown . . .	6.1
Width of crown at 3rd ridge (greatest) . .	4.1
Ditto at 11th ditto . . .	3.7
Height of crown at 12th ridge . . .	7.1

These Khanoos molars are intermediate in character, between the Mammoth and the Indian Elephant, but more nearly allied to the latter. The specimens are in a perfectly fossilized condition, the ivory being infiltrated of a salmon colour, with dark mottled patches, like those which accompany dendritic crystallizations, and they are strongly adherent to the tongue. That they are true fossils is confirmed by the fact of Major Garden having found the tusks *in situ.* Elephant-tusks, six-and-a-half inches in diameter, are too valuable to have been left by man to decay along with the skeleton of a domesticated Elephant. In the synoptical table appended to my Memoir on the 'Species of Mastodon and Elephant, &c.,' the Khanoos fossil form is ranged between *E. Indicus* and *E. primigenius*, under the provisional name of *E. Armeniacus.*[*] Captain Spratt, whose indefatigable labours along the shores of the Mediterranean and Black Sea, have been productive of such valuable and varied results, ascertained that remains of a fossil Elephant had been discovered on the banks of the Bosphorus; but the species has not as yet been determined. I have entered on such detail on this point to direct attention to an imperfectly explored region, which promises to yield important results.[†]

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* Pl. II. fig. 2, shows the crown-view of the tooth.

The northern shores of the Black Sea and the Sea of Azof, have yielded indications of the remains of fosil Elephants, the specific identification of which remains to be determined. Lartet refers to molars of *E. meridionalis?* as having been dug up in the trenches before Sebastopol;[‡] and Huot mentions the discovery of Elephant bones at Sympheropol, which he assigns to *E. primigenius*, employing the term in the loose comprehensive sense in which it used to be applied to all fossil Elephants met with over the European area.[§] The same remark applies to the Mammoth remains mentioned by the authors of the 'Geology of Russia,' as occurring in the stratum of 'clay-drift' which rests upon the Miocene steppe-limestone at Taganrog, on the shores of the Sea of Azof.[||] It is greatly to be desired that the species of Elephant occurring in these cases should be accurately ascertained. The fact, that so eminent a Proboscidian authority as M. Lartet, has approximatively referred the Sebastopol remains to *E. meridionalis*, coupled with the occurrence of *M. Borsoni*, either in Siberia or the Crimea, is strongly presumptive of pliocene beds, yielding Elephants of a much more ancient date than the Mammoth-yielding gravels of the Urals. The dentition of *E. meridionalis*, in the ridge-formula, is identical with that of the miocene fossil *Elephas planifrons* of the Sewalik Hills, and the characters yielded by the enamel-plates and discs of wear, are also closely conformable; while *E. Armeniacus*, as stated above, approaches nearer to the existing Indian species.

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[*] Quart. Journ. Geol. Society, 1857, vol. xiii. p. 319.

[†] The 'Khanoos' and Bosphorus fossil Elephants appear to furnish an explanation of the statements of Pausanias, respecting the gigantic bones of Geryon, and large horns (Elephant tusks) found near the banks of the Hyllus, in Upper Lydia; and of the colossal bones of the Indian Orontes, together with a gigantic horn, brought to light by digging a deep canal, when a Roman Emperor tried to pass a fleet to Antioch up the Orontes. For the former case, *vide* Pausan. Attic. Lib. i. cap. xxxv; and for the latter, *idem.* Arcad. Lib. viii. cap. xxix. Also Cuvier, Oss. Foss. 4to. tom. i. p. 152, 3d Edit.

[‡] Bullet. Sociét. Géolog. de France, 3d. Sér. (1859) tom. xvi. p. 500.

[§] Demidoff's 'Voyage dans la Russie Méridionale," &c. tom. ii. pp. 457 and 564.

[||] Op. cit. Vol. i. p. 502. The authors of this great work appear to consider the Taganrog deposit in question, which they term 'Clay Drift,' or 'Mammoth Drift,' to be identical with the 'Mammoth Drift' of Central and Southern Russia, and to have been a result of submergence, like that of the Lowlands of Northern Siberia, when Mammoth bones were transported into its estuaries. But it still remains to be proved that the Arctic Ocean of the Glacial period ever invaded the Aralo-Caspian province of which the Sea of Azof was a part. We have the high authority of Woodward for the fact that the Aralo-Caspian basin contains only a single species, (*Cardium edule, var. rusticum*) common to it and the White Sea. ('Manual of Mollusca,' p. 431). Huot considered the Crimean deposits, yielding Elephant remains, to be of fresh water origin.

There is another point connected with distribution of fossil Elephants over the European area, to which I am desirous of directing the attention of Palæontologists. I now entertain a strong suspicion that remains of *E. Armeniacus*, or a form closely allied to it, occur in Italy. This impression is founded upon specimens which I observed in the Natural History Museum of Turin, in the University Museum of Pisa, in the private collection of the Marchese Carlo Strozzi, at Leghorn, and in those of Professor Ponzi and Signor Ceselli, at Rome, the satisfactory specific identification of which puzzled me greatly. They certainly cannot be referred either to *E. meridionalis*, or to *E. antiquus*, from the high numerical expression of their ridge-formula, nor do they appear susceptible of identification with *E. primigenius*, without straining the distinctive characters of that species to a degree which is not warranted by our experience of it elsewhere. The first which I shall adduce in illustration, are a series of molars, discovered in the Astigiano, during the excavation of the railway-section between Alexandria and Turin. One of them is a huge last upper molar, right side, in the finest preservation, and half-worn. The crown is not quite perfect in front, the portion borne upon the large anterior fang having been worn down and broken off. What remains of it presents no fewer than twenty-four ridge-plates, including the hind talon: and of these the twelve anterior ones are more or less worn, the rest being intact. The crown is very broad in front, and the plates, where unworn, are very high, as will be seen by the dimensions annexed. The discs of wear are transverse, without mesial expansion; they are not so open as in the Indian Elephant, but wider than in the Mammoth, except in specimens of the latter, worn low down; and they exhibit nothing of the retroflexion of the lateral cornua, commonly seen in *E. antiquus*. The enamel-plates are flexuose in the middle with decided crimping there, which does not extend to the sides; they are thicker than in *E. primigenius*, but less so than in *E. antiquus*. In this respect they resemble most *E. Armeniacus* and *E. Indicus*. The space occupied by the twelve discs of wear, measured along the summit of the crown, is 7 inches, yielding an average of about .6 inch to each, which comes very near that indicated above in *E. Armeniacus* of Khanoos, *i. e.* .57.

The principal dimensions are: —

Length of crown (not quite entire)	13.75	inches
Extreme width of do.	4.5	„
Height of crown at 12th ridge	8.	„
Space occupied by the 12 discs of wear	7.	„

I have detailed notes, of numerous other molars, exhumed on the same occasion, from the same locality, St. Paolo, or near it, 'Nizza della Paglia,' which yield similar characters. My first notes were taken in July, 1856, and in April, 1861, I re-examined the materials, the interval having afforded me ample opportunities of examining the molars of fossil Elephants, over the European area. With the reserve suggested by the fact, that I have not been able to confront the originals, or good drawings of them, I have been led to identify the 'Khanoos' and St. Paolo molars as being of the same species, *E. Armeniacus*, and to consider, that they are not referable either to *E. primigenius* or *E. antiquus*. The same remark applies to specimens which I examined along with Prof. Meneghini in the museum at Pisa; to a specimen of which I saw a cast in the possession of Marchese C. Strozzi, the original procured from the Val de Mugello, an affluent of the Sieve; and to specimens in the possession of Professor Ponzi and Signor Ceselli, from the volcanic gravels around Rome. I may further add, that I failed to distinguish from the existing Indian Elephant, the last milk molar, from the Grotta of San Teodoro, in the lower jaw, figured by my friend Baron Anca;* and that I discovered in the Grotta of Maccagnone, a last upper milk-molar, presenting similar characters; neither is reconcileable with *E. primigenius* or with *E. antiquus*. I dwell upon these facts in the hope, that the attention of Italian Palæontologists may be attracted to the subject, and that they may follow up the investigation. We now possess, through the accurate researches of M. Lartet, conclusive evidence that the existing African Elephant formerly extended its range to Southern Europe; and it would hardly be more unexpected to find that the Indian Elephant, or a form closely allied to it, had ranged into Asia Minor and Italy.

§ 8. Persistence in time of the Distinctive Characters of the European Fossil Elephants.

Having long enjoyed the privilege of intimate intercourse with Charles Darwin, I have been for many years familiar with the gradual development of his views on the Origin of Species; and I have been included by him in the category of those who have vehemently maintained the persistence of specific characters. My attention has, in consequence, been closely directed to the evidence yielded by the Pliocene and Quaternary deposits of Europe in its bearing on the question, in so far as the fossil Mammalia are concerned.

Commencing with the older Pliocene strata of the Subapennines, and of the Val d'Arno, and ascending to the superficial gravels or quaternary deposits of comparatively modern origin, at least four well defined species of fossil Elephant have been ascertained to have existed in Europe, namely, *E.* (*Loxodon*) *meridionalis*, *E.* (*Euelephas*) *antiquus*, *E.* (*Euelephas*) *primigenius*, and *E.* (*Loxodon*) *Africanus fossilis*.* A vast number of remains of the three first named of these species, have been exhumed over a large area in Europe; and, even in the geological sense, an enormous interval of time has elapsed between the formation of the most ancient and the most recent of these deposits, quite sufficient to test the persistence of specific characters in an Elephant. Do then the successive Elephants, occurring in these strata, show any signs of a passage from the older form into the newer? or what light do they throw on the general question?

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* Bullet. Sociét. Géol. de France, 2e Ser. tom. xvii. p. 684, Pl. xi. figs. 8 and 8*a*.

It is obviously beyond the scope and limits of the present communication, to enter at length on the details of this great argument. I shall confine myself briefly, and with diffidence, to the results to which one observer, whose attention has been earnestly fixed on the subject, has been conducted.

If there is one fact, which is impressed on the conviction of the observer with more force than any other, it is the persistence and uniformity of the characters of the molar teeth in the earliest known Mammoth, and his most modern successor. They maintain unchanged, the same numerical formula of the colliculi, in the successive teeth; the same great breadth of crown relatively to its length; the same condensation of the constituent materials; the same narrow parallel-sided transverse bands in the discs of wear; the same general absence of crimping in, and tenuity of, the enamel-plates; and uniformly the same flatness of the plane of wear. It may be urged, that the observation is here limited to the characters of a single organ, and that to justify any well-founded generalisation, the comparison should be carried throughout the skeleton. The objection would apply forcibly in the case of living forms; not merely the skeleton, but the soft parts, and the texture of colouring and the dermal appendages, would all require to be taken into account.

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* I omit from the list *E.* (*Loxodon*) *priscus* (vide Synop. Table, Quart. Journ. Geol. Soc. 1857, Vol. xiii. p. 319,) which I now regard as being a form of *E. antiquus*, and *E. Armeniacus*, or the fossil Elephant of Sicily and Italy, which is closely allied to the existing Indian species, in order to relieve the argument of any elements, which may not be considered as being at present established on sufficient evidence. I omit also, an undescribed fossil Elephant, from the ossiferous caves of Malta, which is in some respects the most remarkable and unexpected form that has yet been discovered, fossil or recent. The conception of an Elephant is associated in the mind, with the familiar idea of colossal size. *E. Melitensis*, the name which I have applied to the new species, was the Pigmy form of the order. I am in possession of a last cervical vertebra of an adult animal, the body of which does not exceed 2.8 inches in vertical diameter, and 0.95 in thickness, with a humerus of a younger, but nearly adult individual, the entire length of which was not more than 10 inches. The species was discovered through the researches of Capt. Spratt, C.B., of H.M. ship 'Medina,' to whose indefatigable labours in the Mediterranean, science is so deeply indebted. The discovered remains, now entrusted to my charge, include nearly the entire dentition, from the new-born calf up to the adult animal, of numerous individuals. In the Systematic Series, it belonged to the sub-genus *Loxodon*, and in size, stood between a large Tapir and the small unicorned Rhinoceros of Java.

But with fossil forms, this is manifestly impossible. The compass of a single life would hardly suffice, even, for a rigorous comparison of the details of the skeleton in all the geographical localities and geological deposits in which the remains of the Mammoth have been found. The observer is thus constrained to a selection. Through a wide range of observation on living forms, we know the constancy with which the characters of the teeth are maintained in the same species; and having faith in the order of nature, we extend the rule to extinct forms. The result of my observation is, that the ancient Mammoth of the pre-glacial 'Forest-bed' of the Norfolk coast, differs less from the later form occurring on the banks of the Lena, than does the latter from the comparatively modern Mammoth of the superficial bogs of North America, which I regard as being only a slight geographical variety of the same species.

The same evidence, I believe, is borne by the organs of locomotion; but the exposition of this part of the case is beyond the limits of the present occasion.

Assuming the observation to be correct, what strong proof does it not afford of the persistence and constancy throughout vast intervals of time, of the distinctive characters of those organs which are most concerned in the existence and habits of the species? If we cast a glance back on the long vista of physical changes which our planet has undergone since the Neozoic Epoch, we can no where detect signs of a revolution more sudden and pronounced, or more important in its results, than the intercalation and subsequent disappearance of the Glacial period. Yet the 'dicyclotherian' Mammoth lived before it, and passed through the ordeal of all the hard extremities which it involved, bearing his organs of locomotion and digestion, all but unchanged.

Taking the group of the four European fossil species above enumerated, do they show any signs, in the successive deposits, of a transition from the one form into the other? Here again, the result of my observation, in so far as it has extended over the European area, is, that the specific characters of the molars are constant in each, within a moderate range of variation, and that we nowhere meet with intermediate forms. The specific difference in the molars, be it observed, rests upon a much more deep-seated foundation than the superficial indication, merely, of 'thick-' and 'thin-plated' varieties. This I shall endeavour to explain with the help of figures. Taking *Mastodon Ohioticus* at one end of the chain, and *E. primigenius* at the other, the number of ridges in the last milk molar, and the three consecutive true molars, yields, in the former, the ciphers 3 : 3, 3, 4; while in the latter, they rise to 12 : 12, 16, 24. The groups of forms interposed between these extremes, yield intermediate numerical formulæ, which are very constant in each species, within a moderate range of individual variation. Thus, the *Mastodon Arvernensis* gives 4 : 4, 4, 5; *Elephas* (Lox.) *meridionalis* 8 : 8, 9, 12; *E.* (Lox.) *Africanus* 7 : 7, 8, 10-11; *E. antiquus*

10 : 10, 12, 16. We nowhere find in the successive deposits in Europe, indications of a transition from *E. meridionalis* to *E. antiquus*, which could be represented by a formula between 8 : 8, 9, 12; and 10 : 10, 12, 16: nor between the latter species and *E. primigenius* by a formula intermediate to 10 : 10, 12, 16; and 12 : 12, 16, 24. The difference is so great, that the penultimate upper true molar (m. 2), which in *E. meridionalis* does not exceed nine ridges, attains in the Mammoth 16. And it is further to be borne in mind, that these numerical distinctions in the divisions of the crowns of the molars, are accompanied by other specific characters which are equally constant.

The inferences which I draw from these facts, are not opposed to one of the leading propositions of Darwin's theory. With him I have no faith in the opinion, that the Mammoth and other extinct Elephants made their appearance suddenly, after the type in which their fossil remains are presented to us. The most rational view seems to be, that they are in some shape the modified descendants of earlier progenitors. But if the asserted facts be correct, they seem clearly to indicate that the older Elephants of Europe, such as *E. meridionalis* and *E. antiquus*, were not the stocks from which the later species *E. primigenius* and *E. Africanus* sprung, and that we must look elsewhere for their origin. The nearest affinity, and that a very close one, of the European *E. meridionalis* is with the Miocene *E.* (*Loxod.*) *planifrons* of India; and of *E. primigenius* with the existing Indian species. Another reflexion is equally strong in my mind, that the means which have been adduced to explain the origin of species by 'Natural Selection,' or a process of variation from external influences, is inadequate to account for the phenomena. The law of Phyllotaxis, which governs the evolution of leaves around the axis of a plant, is nearly as constant in its manifestation, as any of the physical laws connected with the material world. Each instance, however different from another, can be shown to be a term of some series of continued fractions. When this is coupled with the geometrical law governing the evolution of form, so manifest in some departments of the animal kingdom, *e. g.* the spiral shells of the Mollusca, it is difficult to believe, that there is not in nature, a deeper seated and innate principle, to the operation of which 'Natural Selection' is merely an adjunct. The whole range of the Mammalia, fossil and recent, cannot furnish a species, which has had a wider geographical distribution, and at the same time passed through a longer term of time, and through more extreme changes of climatal conditions, than the Mammoth. If species are so unstable, and so susceptible of mutation through such influences, why does that extinct form stand out so signally a monument of stability? By his admirable researches and earnest writings, Darwin has, beyond all his cotemporaries, given an impulse to the philosophical investigation of the most backward and obscure branch of the Biological Sciences of his day; he has laid the foundations of a great edifice;

but he need not be surprised, if, in the progress of erection, the superstructure is altered by his successors, like the Duomo of Milan, from the Roman to a different style of architecture.

§ 9. UNITY OR PLURALITY OF SPECIES IN THE EXISTING ASIATIC ELEPHANTS.

This question has an important bearing on that of the fossil species which we have just discussed. It is averred, that from the time of Cuvier up to the present day, zoologists have been commonly in error in regarding the Elephants of Eastern Asia as all belonging to one species, *E. Indicus;* that there are two well marked forms confounded under this name, the one limited to Continental India, the other insular, called *E. Sumatranus*, inhabiting Sumatra and Ceylon, and probably extending also to the Trans-Gangetic portion of the Continent. Let us see upon what evidence these assertions are founded.

The opinion, so far as I am aware, was first broached, but in a very general and conjectural way, by Mr. B. H. Hodgson, the eminent ethnologist and explorer of the zoology of Nepal, who, in a communication to the Zoological Society, in 1834, suggested that there are two varieties, or 'perhaps rather species,' of the Indian Elephant, the Ceylonese and that of the Sal forests: the Ceylonese having a smaller and lighter head, which is carried more elevated, and having also higher fore-quarters; while the Elephant of the Sal forests has sometimes five nails on its hinder feet.*

In 1847, Temminck brought out a work embodying a general survey of the resources and productions of the Dutch East India possessions, in which there appeared a brief notice of a supposed new species of Elephant, named *E. Sumatranus*.† As Temminck's strength as a naturalist lay in ornithology, the announcement did not carry with it the weight of authority, when opposed to the opinion of Cuvier, and other eminent zoologists. But it now appears that the inference originated with the distinguished Dutch zoologist, Professor Schlegel, and that Temminck's work was simply the vehicle in which the results arrived at by the latter, first appeared.

In 1847 I visited Leyden, for the express object of examining the materials preserved in the Museum there, upon which *E. Sumatranus* was founded; by the aid of Prof. Van der Hoeven, I was enabled to see them, although only in a cursory manner, owing to the shortness of the time at my disposal; and the inspection failed to satisfy me that *E. Sumatranus* was distinct from the continental Indian Elephant, with which I had been familiar in its native haunts, during many years.

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* Zoological Proceedings, 1834, p. 96.

† 'Coup d'œil général sur les Possessions Neederlandaises,' &c., 8vo. 1847, tom. ii. p. 91.

In 1849, the late Prince of Canino (Charles L. Buonaparte) made a communication to the Zoological Society, in which he affirmed that *E. Sumatranus* of Temminck was intermediate between the Continental Indian and African Elephants; and that the differences in the form of the skull, and in the teeth, were so pronounced as to put an end with certainty to the subgeneric distinction between *Elephas* proper and *Loxodon.*[*] But there are errors of statement in the Prince of Canino's brief notice which divest it of the authority of accurate or original observation. He even asserts that the "undulated ribbons of enamel are nearly quite as wide as those forming "the lozenges of the African."

Last year, Professor Schlegel, whose attention has been continually directed to the subject since 1845, communicated a paper to the Academy of Sciences of Holland, in which he lays claim to the authorship of the opinion first put forward in Temminck's work, and maintains it upon extended observation.[†]

In order to facilitate their examination, I shall classify the distinctions which have been adduced, from first to last, in support of the view, although some of them have been abandoned in the progress of the inquiry.

I. *External characters.*—Small ears, and general form, both, as in the Continental Elephant; but the Sumatran species more slender and more finely built; trunk longer and more slender; extremity of the tail more dilated, and invested with longer and stronger bristles, in this respect reminding one more of the African than the Indian species. (Schlegel).

II. *Greater degree of intelligence and aptitude for instruction.* (Diard in Schlegel).

III. *Osteological characters.*

(A.) General construction of the skeleton and form of the cranium alike, but:

1. Free part of intermaxillaries shorter and narrower.
2. Nasal aperture more contracted.
3. Inter-orbital space narrower.
4. Posterior part of the cranium wider. (Schlegel in Temminck).
5. Form of skull intermediate between African and Indian. (C. L. Buonaparte).

(B.) *Molar teeth.*—Ribbons (discs of wear) in form like those of the Indian species, *i. e.*, the enamel-plates highly crimped, parallel, and free from the rhomb-shaped expansion of the African Elephant; but the ribbons wider (in the direction of the long axis), and *consequently less numerous than in the Indian species;* the difference being in the ratio of 3 or 4 : 1 in the Sumatran, and 4 or 6 : 1 in the Continental Indian form, (Schlegel in Temminck). Ribbons of enamel nearly quite as wide as in the African Elephant. (C. L. Buonaparte).

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[*] Proceed. Zool. Soc. 1849, p. 144.

[†] 'Bijdrage tot de Geschiedenis van Olifanten, voornamelijk, *Elephas Sumatranus,*' translated by Dr. Sclater, Nat. Hist. Review, 1862, Vol. ii. p. 72.

(C.) *Vertebræ and ribs.* — The following numerical differences have been indicated by Prof. Schlegel; they vary in some unimportant respects, according to the statements of different dates:

	African Elephant.		Sumatran Elephant.		Indian Elephant.	
	In Temminck.	Schlegel.	In Temminck.	Schlegel.	In Temminck.	Schlegel.
Cervical vertebræ .	7	7	7	7	7	7
Dorsal vertebræ .	21	21	20	20	19	19
Lumbar vertebræ .	3	3	3	3	3	3
Sacral vertebræ .	4	4	4	4	5	4
Caudal vertebræ .	26	26	34	33	34	33
*True ribs . .	6	5	6	5	6	5
False ribs . .	15	16	14	15	13	14
Pairs of ribs . .	21	21	20	20	19	19

According to this table, the Continental Indian Elephant has only 19 dorsal vertebræ and 19 pairs of ribs; while the Sumatran species has 20 of each, the African Elephant having 21; being differences which, if proved to be constant, would be of considerable systematic importance.

The difference in external form, between the Indian and African species, is so pronounced, that either can be told off at a glance, even from the stamp of a Greek or Roman coin. Admitting the general form and small ears to be alike, in the Indian and Sumatran Elephants, Professor Schlegel has only a slight difference in slenderness of the general proportions, a more slender form of the trunk, and a larger terminal fringe of bristles to the tail,† to rely upon. But even in the Sal forests of North-Western India, at the extreme northern limit of the species at the present day, the difference of slender-built and squat-built Elephants is well-known, being expressed by Corse, for the Bengal variety, under the designation of '*mirghi*,' or Cervine for the former, and '*Koomarea*' for the latter, or when the characters are combined '*Sunkareah*.'† The trunk varies in a similar manner, being somewhat short and thick in some, and long and more slender in others. The fringe of bristles to the tail, is variable in degree, according to the sex, age, and vigour of the animal. A good fringe is seldom retained long in captivity; when present, it always enhances the price of the animal in the estimation of the natives of India. That the animal varies considerably in appearance, according to the district in which he has been captured, has long been well known in India. Aboo Fuzl, in his account of the Elephant stables of Akbar, enumerates six varieties, distinguished by form, different marks, or colouring;‡ and the experienced mahouts attached to the Government Commissariat in Bengal, will tell, at a glance, the district where a recently caught Elephant has been bred;§ whether the Sal Forests of the North-West Provinces, Assam, Silhet, Chittagong, Tipperah, or Cuttack. The distinction, therefore, founded upon the external characters of *E. Sumatranus*, completely fails.

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* Schlegel expressly states, "that the number of true ribs is alike in all the species, that is only five;" but there is evidently a numerical slip in the ciphers which he immediately afterwards assigns to the false ribs, namely, 15, 14, and 13 respectively, in the three different species, which would give a total of 20, 19, and 18, instead of 21, 20, and 19, being the asserted aggregate of pairs corresponding with the assigned number of dorsal vertebræ in the different species. (Nat. Hist. Review, Vol. ii. p. 75).

† The distinctions indicated were, according to the statement of Prof. Schlegel, founded on the observation of Heer Westermann, upon two female Elephants in the Zoological Garden at Amsterdam, the one from Calcutta, the other Sumatran. It must be admitted, that the number of objects compared, is hardly sufficient to sustain the position. The original passage in Schlegel's memoir is thus:—"Dat het "een' langeren en dunneren snuit heeft; dat de Staart aan het einde meer afgeplat "en met langere, zware haren bezet is," &c. The version given in the 'Nat. Hist.

I believe that the same could be shown, as regards the asserted difference of intelligence and aptitude for instruction; but as this is not a tangible, specific character, I leave it undiscussed.

The Osteological distinctions in the skull, which Prof. Schlegel advanced in Temminck's work, he has since seen reason to abandon. But the identity of form is a strong argument in support of the unity of species. Not only is the general form of the cranium alike in both, but the relative proportions, and connexions of constituent bones, are the same in the wild Elephant of the North-West Provinces and in that of Ceylon. The difference of variety, implied by the terms '*Mŭkna*,' 'small-tusked,' and '*Dauntela*,' large-tusked, necessarily involves a proportional degree of difference, in the development of the intermaxillary bones, in the depth and breadth of the trough between the tusk sheaths, and in the amount of development of the occipital bosses. But the connéxions of the bones remain the same; and all the leading modifications of form and proportion, so clearly indicated by Cuvier, as distinctive of the Indian from the African form, are maintained in the Continental aud Ceylon Elephants, within a range of variation which is common to both.

Review,' is "that the *rump* at the end is more broadened, and covered with longer "and stronger hairs," (Op. cit. p. 76). In Tennent's 'Natural History of Ceylon,' the character of flattening with longer hair, is made to apply to the extremity of the *proboscis*, instead of the *tail*. (Op. cit. p. 66.) The version given in the text is the correct one.

† Philosoph. Transacts. 1799, p. 205.

‡ Ayeen-Akberry, translated by Gladwin, Vol. i. p. 126.

§ Hooker, 'Himalayan Journal,' Vol. ii. p. 302.

The metropolitan collections furnish excellent and authentic materials for testing the accuracy of this statement in two magnificent skulls of adult wild Elephants, both killed in combat by gunshot wounds. The one (No. 2656, Osteol. Cat.) is preserved in the Museum of the College of Surgeons, the other in the Zoological Department of the British Museum. The former is of a large Ceylon Elephant, which bears the open canals (one of them nine inches deep) of three bullet wounds, of old date, that had been repaired by nature, in addition to its recent death-wounds; the latter, of a most destructive Solitary, or '*Goondah*' wild Elephant, which, for a long time was the terror of a district, near which I then resided. It was killed in the jungles, on the banks of the Ganges, at no great distance from Meerut, in May, 1833, by a party of four experienced sportsmen, who went out for the express purpose of killing it. The savage animal made no fewer than twenty-three desperate and gallant charges against a battery of at least sixteen double-barreled guns, to which it was exposed on each occasion, and fell, after several hours, with its skull literally riddled with bullets. Besides the shot holes of its last engagement, the frontal plateau alone bears, above the nasals, the healed canals of at least sixteen bullet-wounds received in previous encounters, exclusive of those effaced by the confluent fissures of its latest wounds. Meerut is in lat. 29°, close to the extreme northern limit of habitat of the Indian Elephant. If the two skulls, from localities so wide apart, are compared, they agree in general form and proportions; and in the details of pyramidal summit, long concave frontal plateau, inial fossa, occipital bosses, nasal aperture, position of the orbits, form and connexions of the lachrymary, length of incisive sheaths, &c.

On the other hand, in all the well determined species, fossil or recent, of which perfect crania are known, we invariably find, that the latter yield strongly marked distinctive characters even when molar teeth are similar. In illustration I may cite *E. primigenius*, *E. Indicus*, *E. Hysudricus*, *E. Namadicus*, *E. planifrons*, *E. meridionalis*, and *E. Africanus*, in no two of which are the crania alike. While in the Ceylon and Indian Elephants, they are so closely similar, that, in a museum, without a record, the mere form will not instruct the observer whence the specimen came—whether continental or insular. The statement made in the Zoological Proceedings of 1849, as to the amount of difference, is clearly an exaggeration. (antea p. 82.)

As regards the molar teeth, it is stated in Temminck's 'Coup d'œil,' in reference to the discs of wear, that, "ces rubans sont de la largeur "de ceux qu'on voit à la couronne des dents de l'Elephant d'Afrique; "ils sont conséquemment moins nombreux que dans celui du Conti-"nent de l'Asie." In Professor Schlegel's later communication, the statement is modified as follows:—

"The laminæ of the teeth afford another distinction, which how-"ever is less apparent to the eye than that taken from the number "of vertebræ. These laminæ, or bands, in *E. Sumatranus*, are wider "(or if one may so say, broader in the direction of the long axis of "the teeth) than in *E. Indicus*. In making the comparison, one "may remark that the distinction is less evident in younger individuals, and that there are met with, in all species of Elephants "within certain definite limits, remarkable individual differences in "respect of the width of these laminæ." (Nat. Hist. Rev. ii. p. 75.)

Here it will be observed, the distinction is propounded subject to so many qualifications, as to render it elusive for any practical use. I have ascertained, after the examination of a very large quantity of materials in India and Europe, that the ridge-formula in the Indian Elephant runs thus :—

$$\overbrace{\frac{4,\quad 8,\quad 12}{4,\quad 8,\quad 12}}^{\text{Milk Molars.}} : \overbrace{\frac{12,\quad 16,\quad \overbrace{20\text{-}24.}}{12,\quad 16,\quad 20\text{-}24.}}^{\text{True Molars.}}$$

The increase in the number of the ridges of the successive teeth, takes place as in *E. primigenius*, by increments of 4, repeated in two series, the first of which terminates with the last milk molar. The second series commences with the antepenultimate or first true molar, which *constantly repeats* the number presented by the last milk molar, *i. e.* 12 ; the penultimate (m. 2) shows an increment of 4, the number of its ridges being normally 16. The last true molar never shows less than 20, commonly about 22, but sometimes, in the lower jaw, attaining as many as 27 ridges. This liability to variation in the last true molar is well known, and runs more or less through all the species of *Elephant* and *Mastodon*.* But the ciphers, shown above, are very constant, in the three intermediate molars, (*i. e.* the milk molar, and the antepenultimate and penultimate true molars) namely, 12: 12, 16. I do not mean to affirm, that they are absolute and invariable ; but that the above formula is a fair exponent of the results yielded by a great majority of instances, on the comparison of a very large quantity of materials. For example, the penultimate milk molar (m. m. 3), occasionally presents only 7 ridges ; while the antepenultimate true molar, of the lower jaw, in some cases, exhibits as many as 14 ; the variation being dependent, partly on the greater or less development of the talon ridges, which are very inconstant, and, as I have elsewhere stated, partly on the race, sex, and size of the individual.† I rest the more stress upon the importance of the ridge-formula, since, whenever the the element of quantity can be shown to hold, in the animal organization, it becomes a powerful aid to research, and a criterion to test the accuracy of observation. In the fossil *E. antiquus* of Europe, the dentition of which I have been able to determine with precision, the formula for the three intermediate molars, and the last true molar, above and below, is 10: 10, 12, 16, being nearly intermediate between the Indian and African Elephants. If then, as asserted, the number of bands (*i. e.* ridges) is less in the Sumatran and Ceylon form, than in the Continental Indian, the ridge-formula ought to show a lower series of ciphers. Professor Schlegel tells us, that he has had the advantage of examining at least seven skeletons, including young individuals, besides several skulls of *E. Sumatranus*, furnishing ample materials for determining the number of ridges in the different teeth. Yet neither he, nor any of the other advocates of distinctness of the species, has as yet attempted to show, by adduced instances, that the numbers are less; and until that is done, the general and therefore vague assertion of the fact, cannot be admitted as of sufficient weight. In the skull of the large Ceylon Elephant above referred to (No. 2656. Osteol. Cat. Coll. Surg.) the last true molar above and below, shows 22 ridges; a penultimate upper right molar, in the collection of Mr. Prestwich, and of undoubted authenticity, as having been imported from Ceylon, still shows 15 ridges, although the most anterior portion is worn out, with the loss of one ridge; while the penultimate lower, of a Sumatran skull figured by Blainville,* distinctly shows 16 ridges, besides a hind talon. These instances prove, so far as they go, that the ridge-formula is the same in the Ceylon and Sumatran form, as in the Indian.

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* For illustrations of the fact in *Mastodon Ohioticus*, vide Warren. *Op. citat.* p. 79 ; and for its general occurrence in the family, vide Lartet. *Bullet. Géol. Soc. de France*, 2e série, tom. xvi., note, p. 498.

† Quart. Jour. Geol. Soc., 1857. Vol. xiii. p, 315.

Next, as regards the width of the bands (discs of wear). This is a most deceptive character if merely regarded *per se*, since it varies very considerably, even in the same molar, at different stages of detrition: 1st, because the ivory cores of the ridges, being wedge-shaped, the discs of wear are necessarily narrower at their apex than at their base; 2nd, because, as already stated (supra p. 66), the plane of abrasion, instead of being perpendicular to the axis of the wedges, cuts them obliquely, the obliquity increasing with the advance of wear, and constantly tending towards the horizontal. The consequence is, that the width of the discs is always exaggerated in a tooth worn down to the base, and that the anterior discs are wider than the hinder ones. The only accurate method of ascertaining the number of ridges, within a given space, is to measure the crown, not at the summit, but along the base where the enamel-plates are reflected; the product will then give the average width of each ridge. The skull of the Ceylon Elephant (No. 2656, Coll. Surg.), supplies excellent and readily accessible materials for testing the value of the alleged character, in the so-called *E. Sumatranus*. It contains above and below, the penultimate and last true molars in action; the former in advanced wear, the latter coming into use, and in the upper jaw, barely abraded. The right upper penultimate is worn low, with a loss of the anterior portion. The crown presents the discs of eight distinct ridges, together with a denuded base of ivory in front, corresponding with two ridges that have been worn out. These discs are wide, with highly crimped enamel *machærides*, both being of the *E. Sumatranus* pattern; the following are the principal dimensions:

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* Ostéographie Éléphants Pl. ix. fig. 6. De Blainville numbers the tooth as a 6th or last, but it is manifestly a 5th, or penultimate.

Length of crown measured at summit	8.	inches.
Space occupied by the 7 last discs of wear	5.8	„
Greatest width of crown	3.0	„

In this case, the discs are very open, with an average width of about .83 in. to each; but in the progress of wear, the ridge-plates have become so reclinate, in relation to the plane of detrition, that in the middle of the crown, from the causes above assigned, the grooved enamel plates are exposed, nearly horizontally, to the extent of nine-tenths of an inch. The width of the bands, in this instance, is an exaggeration arising from the obliquity of the section yielding them, in a tooth far advanced in wear.

The last true molar of the same skull makes a different appearance. Although partly extruded it is hardly touched by wear, and the outer wall of the alveolus was removed to expose the concealed hinder portion. The crown is composed of 22 ridge-plates, of which 18 are consolidated, the 4 hindmost being loose. It yielded the following dimensions:—

Extreme length, measured diagonally, from apex of front ridge to base of the last do.	13.	inches.
Length of do. measured along the base of the ridges	11.5	„
Greatest width	3.1	„

Instead, therefore, of .83 yielded by the penultimate, the ridges in this case give only an average of .52 in.; and in weighing the result, it should be borne in mind, that the three last true molars, not only increase successively in the number of their component ridges, but that the latter are proportionally thicker in the older teeth, being an adaptation of nature, to suit the long term of use, which the last molars have to serve. Here then are two consecutive molars of the same skull, which, if detached, and introduced into a museum without a knowledge of their origin, might be cited—the penultimate as a typical illustration of *E. Sumatranus*, and the last of *E. Indicus.*

Nor is this width of the bands, in worn molars, confined to the Southern Elephant. I have now before me two grinders, picked up by Sir Proby Cautley, in the swamp of Azufghur, a habitual resort of wild Elephants, in the *Tarai* of the 'Sal Forests,' at the foot of the Himalayah north of Meerut, which present the characters of the discs of wear attributed to the Sumatran Elephant. There is, doubtless, a certain amount of difference to be met with in the teeth of different Elephants living in the same forests; but it is common to the Northern as well as to the Southern form, and, as yet, there are no good grounds to believe that it ever attains the importance of a specific distinction. The discs of wear in the Ceylon and African Elephants never present a similitude, except when the slightly abraded crown of the latter is confronted with the worn out and *torso* crown of the former.

The most important part of Professor Schlegel's case remains to be considered, namely, the number of the dorsal vertebræ and ribs. Here, also, I find my observations at issue with the conclusions of this distinguished Zoologist. He avers not merely that the number of the former differs in the supposed three living species, namely, 21 in the African, 20 in the Sumatran, and 19 in the Indian, but thinks that he has detected a curious inverse relation between these numbers and the thickness of the laminæ of the molars; where the latter are most attenuated the number of dorsal vertebræ is least. If the inference were well founded it would be of high interest. I quote the passage containing it *in extenso*:—" If we take into consideration " at once the size of the laminæ of the teeth, in the different species " of Elephant, and the number of the ribs and dorsal vertebræ, we " obtain the remarkable result, that as the latter numbers decrease " the laminæ become narrower. In *E. Africanus*, these laminæ are " widest, and here we find the greatest number of dorsal vertebræ " and pairs of ribs: *E. Sumatranus*, in which the laminæ are " narrower, has twenty dorsal vertebræ and pairs of ribs: *E. Indicus*, " in which they are still narrower, only nineteen. In the Mam" moth, *E. primigenius*, where they are narrowest of all, the number " of dorsal vertebræ and ribs appears to be only eighteen."* Extending the comparison to the Mastodons, and finding that *M. Ohioticus* has only twenty dorsal vertebræ, and an equal number of ribs, while its crown-ridges are reduced to three or four, he concludes that the *Mastodons* form not a diverging, but a parallel series with the Elephants. The case, therefore, concerns not merely the Continental and Sumatran varieties of the Indian Elephant, but is a vital question 'pro aris et focis,' affecting the whole of the *Elephantidæ*, fossil and recent. For this reason I must be permitted to examine it in some detail.

And first as regards the asserted number in the African Elephant. Professor Schlegel twits Cuvier with having neglected to compare skeletons of the different species of Elephant, and having thus deprived himself of the merit of the discovery of the third living species. Is the reproach well founded? The only skeleton of the African form, which existed in the Parisian collections when Cuvier died, and even when Blainville wrote upon the family in 1844,† was that of an adolescent female which lived for some time in the menagerie of Louis the Fourteenth at Versailles.[*] It was imported from Congo; and we have the expressed or implied authority of four most eminent and experienced French comparative anatomists, namely, Daubenton, Cuvier, Laurillard, and Blainville, that it had only 20 dorsal vertebræ, and 20 pairs of ribs. Perrault, who dissected the animal, assigns the same numbers; and the accurate Daubenton, who enumerates the dimensions of all the bones in such minute detail, says—"Il y a vingt vertèbres dorsales, et vingt côtes de chaque coté."[†] He assigns the following numbers to the different divisions of the column:—7 cervical, 20 dorsal, 3 lumbar, 3 sacral, 31 caudal vertebræ, and 20 pairs of ribs, of which 7 true and 13 false. Laurillard, as is well known, stood to Cuvier in the same relation of aid, as Daubenton did to Buffon, although he never was formally recognised as his collaborateur. When Perrault's skeleton passed into their charge, Cuvier could only state the number which they saw, and finding the dorsal vertebræ to be the same as in the Indian skeletons which he had dissected, namely 20, he naturally assumed that to be the normal number in both the living species, as Peter Camper did on the same grounds.

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* Bijdrage, &c. *Eleph. Sumatranus; vide* Translation by Dr. Sclater, 'Natural Hist. Review,' vol. ii. p. 78.

† 'Ostéographie,' Éléphants, p. 5.

Skeletons of the African Elephant are very scarce in England. I know of two only, to be found in public collections: the one of an adolescent animal in the museum of Saffron Walden, mounted, and therefore less reliable; the other in the Osteological department of the British Museum, not set up, and in the most favourable state for examination. It is of a young adult, in which the epiphyses are not yet united, imported from the Cape of Good Hope; sex unrecorded. The bones are still covered with the periosteum and shreds of ligament, having not yet undergone the preliminary operation of cleaning. The vertebral column is in masses of from three to five vertebræ, united by ligaments, while others are free. On three different occasions, specially with a view to the present investigation, has the vertebral column been put together by me, scrupulously examining all the surfaces of juncture from the sacrum to the atlas, and the following results were yielded: 7 cervical v, 20 dorsal v, 3 lumbar v, 4 sacral v, 26-30 caudal vertebræ, and 20 pairs of ribs, one of the last pair being wanting.[*] The precise number of the caudal vertebræ could not be determined, as the terminal portion of them is still imbedded in the tail. But there are at the least twenty-six.

We have thus, two instances, the one South African, and the other from Congo, in which the Elephant of that continent, shows only *twenty* dorsal vertebræ. Cuvier is thus relieved from reproach, in so far as this species is concerned.

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[*] Perrault, Mémoir. pour serv. à l'Hist. des Animaux, 1734, Part iii. Pl. xxiii.

[†] Buffon's 'Hist. Natur.' 4to tom. xi. p. 113.

[‡] In order to put the statement beyond question, as resting upon the testimony of a single observer, I requested my friend, Mr. W. H. Flower, the able Conservator of the Museum of the Royal College of Surgeons of England, to examine the skeleton closely, and he arrived at the same numerical results.

The skeleton belonging to the museum at Saffron Walden, is that of a young but nearly adult male, which was imported from Algoa Bay.* It was carefully examined, with reference to the question now under discussion, jointly by Mr. W. H. Flower and myself, and yielded the following numerical results: cervical vert. 7, dorsal vert. 21, lumbar vert. 3, sacral vert. 3, caudal vert. 30, pairs of ribs 21. The dentition was, at the same time, minutely examined, and I can affirm that the characters agreed exactly with those of the skeleton belonging to the British Museum. The skull, and other details of the bony frame, were also alike. The evidence is of the more weight, as both skeletons were derived from Southern Africa; excluding the plea which might have been urged, that they were possibly of distinct species, if they had been procured from different parts of the Continent.†

The cases above adduced, appear to establish the fact beyond question, that the African Elephant varies in the number of dorsal vertebræ from 20 to 21.

Next, as regards *E. primigenius*, what reliable authority has Prof. Schlegel for the conjectural assertion, that the Mammoth had but *eighteen* dorsal vertebræ and ribs? The solitary skeleton,‡ reputed to be nearly perfect, of that species known up to the present time, is the famous Adams-skeleton, preserved at St. Petersburg, and of it there is but one original description extant, namely that of Tilesius, who distinctly states, that it possessed *nineteen* dorsal vertebræ and as many ribs: "Vertebrarum thoracis 19 tantum numeravi, "totidemque costas utriusque lateris, at plurimas e ligno fabre-"factas." § If the statement could be trusted, it would be conclusive against Prof. Schlegel's argument. But there are errors of observation in the account given by Tilesius, which divest it of authority. He describes the neck as being built up of six cervical vertebræ: " Collum ex 6 vertebris compressis et coarctatis compositum." The seventh, he appears to have transferred to the dorsal series. In the large and finely engraved figure which he gives of the skeleton, Pl. X, 21 vertebræ are indicated by spinous processes, jointly to the loins and thorax, and 7 to the neck. Allowing three of these to be lumbar, 18 would be dorsal, as conjectured by Professor Schlegel. But grave imputations have recently been cast upon this celebrated skeleton that, like that of the *Mastodon Ohioticus* of the British Museum, it is a make-up, derived from more than one individual.* Prof. Piazzi Smyth examined it, in company with Prof. Brandt, and states, that the ribs and other parts are restorations made of deal. He sums up his account thus: " The head with much of the skin " hanging upon it, some cervical vertebræ, a whole fore leg, and more " than one foot are, we believe, the genuine Adams Mammoth."† There is therefore, as yet, no trustworthy evidence to show that the Mammoth had only eighteen dorsal vertebræ and ribs; every presumption is in favour of its having had at least nineteen.

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* The Museum at Saffron Walden, affords an excellent illustration of what may be done, by a small provincial town to promote the cultivation of science. It possesses two mounted skeletons of large Pachyderms, which cannot be matched by any of the Metropolitan Collections. The museum reflects great credit on the locality.

† Prof. Schlegel throws out a conjecture, that there may be more than one kind of African Elephant; and in support of it, he refers to two figures of skulls in the 'Ossemens fossiles,' Plate iv. figs. 2 and 10 of Vol. 1, as indicating differences of length and width: but I believe that they are both of the same cranium; fig. 10 representing the front aspect, drawn to a scale of one-twelfth, and fig. 2, the basal aspect on a scale of one-fifteenth. In the latter, the intermaxillary bones are necessarily fore-shortened, from the position in which the skull has been placed, causing a deceptive appearance of short tusk-sheaths.

‡ Of the Mammoth carcasses which, according to the statement of Middendorf, have subsequently been discovered in Siberia, no osteological account, so far as I am aware, has been published. (Bullet. Acad. Petersburg. Class. Phys. iii. p. 150.) The observations of Gleboff refer to the structure of the preserved soft parts. (Bullet. Soc. Imp. Mosc. 1846, xix. pp. 108-134).

§ Mém. Acad. Impér. des Scienc. de St. Pétersburg, 1815, tom. v. p. 503.

Next, as to the number of dorsal vertebræ, in the Indian Elephant.—Skeletons, reputed to be Indian, abound every where, but strange to say, authentic materials for settling this part of the question, are rare, in consequence of the particulars respecting their origin not having been carefully recorded. Until lately, no one doubted that they all belonged to the same species, and the precise locality from which they came was considered to be unimportant.

Prof. Schlegel states that the Sumatran Elephant has constantly 20 dorsal vertebræ, and 20 pairs of ribs. That this number does occur in the Ceylon animal also, is placed beyond question by the careful dissection of a great anatomist, Peter Camper,‡ and by the observations of Cuvier and Blainville, upon the skeletons of two known Ceylon Elephants brought from Holland to Paris in 1795.

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* The mounted 'Koch' skeleton in the National Collection, presents the following vertebræ: 7 cervical, 19 dorsal, 4 lumbar, 3 sacral, and 19 pairs of ribs. It was constructed according to this formula, but the careful observations of Dr. Warren, upon materials of well established authenticity, indicate the following numbers: 7 cervical, 20 dorsal, 3 lumbar, 5 sacral, and 20 pairs of ribs. (Warren, *Op. citat.* p. 25). The lumbar region appears to be built up of bones of different individuals.

† " Three Cities of Russia," Vol. ii. p. 222. I am indebted to Dr. J. E. Gray for a knowledge of this passage; but there are good grounds to believe that the statement is unintentionally overcharged by an astronomer, giving an opinion on a question of comparative anatomy. For Tilesius, whose account, however defective, shows no signs of partiality to Adams, but the reverse, enumerates the parts that have been restored in wood and gypsum; and, as regards the vertebræ, he writes: " Vertebræ omnes genuinæ osseæ, ideoque cartilagine exsiccato inter omnem vertebram instructæ, robustiores Elephantinis." (Op. citat. p. 504). The vertebræ, excepting those of the tail, were less liable to be separated than any other part of the skeleton.

‡ 'Anat. d'un Élèphant Mâle,' p. 63.

The distinguished Dutch zoologist further states, that all the Indian Elephants which he had examined, had, without exception, only 19 dorsal vertebræ and 19 pairs of ribs. That this is occasionally or even frequently the case, is beyond doubt, from the corroborative evidence of Patrick Blair, Meckel, Warren, and others. For, as remarked by Camper, it is highly improbable that a dorsal vertebra should have disappeared in boiling the bones, preparatory to setting them up. But it is by no means equally certain that the number is constantly limited, in the Indian form, to nineteen. Professor Schlegel cites the case of the Duvaucel skeleton, forwarded from Bengal to Paris, in which there are twenty dorsal vertebræ.* But he tries to get over the difficulty of this exceptional case, by the hypothesis, that the live animal may have been imported from Ceylon into Bengal. I will mention in the sequel, the reasons, founded upon many years' residence there, why I consider the assumption to be in the highest degree improbable. It is rare to find the skeleton of an Asiatic Elephant in England, the pedigree of which is so well authenticated, as to be beyond conjectures of this kind. But there is one in London, the antecedents of which are well known, being the skeleton of the celebrated male Elephant, '*Choonee*,' preserved in the Museum of the College of Surgeons. The young animal was imported from Bengal in the year 1810, on board the the E. I. C. ship 'Astell,' by Capt. Hay;† and in 1826 it was shot, in the menagerie at Exeter-Exchange, in consequence of its violence from sexual excitement. It bore an Indian name, 'Choonee,' and on the occasion of its slaughter, it obeyed the word of command to lie down, given to it by its English keeper, in the language of Hindostan. All the antecedents are here consistent in proof that the animal was of a Bengal stock. I have examined the skeleton closely, and find that it has 7 cervical, 20 dorsal, 3 lumbar, 4 sacral vertebræ; and 20 pairs of ribs. The last or nineteenth pair have been lost, or omitted in mounting the skeleton. The twentieth dorsal vertebra presents costal articular cups, which are unsymmetrical and small: that, on the right side, not much exceeding the size of a silver sixpence. But the vertebra is distinctly present. This case, coupled with the Duvaucel skeleton, in the 'Jardin des Plantes,' seems to establish, without searching for others, that the continental Elephant of Northern India varies in the number of its dorsal vertebræ from 19 to 20, as the African varies from 20 to 21.‡

The hypothesis entertained by Professor Schlegel, upon the statement of Diard, that Ceylon Elephants are frequently imported into

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* Nat. Hist. Review, ii. p. 74.

† Griffith's "Animal Kingdom," Vol. iii. p. 348; and Hone's "Every Day Book, &c." Vol. ii. p. 322.

‡ The ingenious view advanced by Prof. Schlegel regarding the inverse relation, between the number of *laminæ* in the molars, and the number of dorsal vertebræ in the different species (supra, p. 89), does not appear to be tenable against

Bengal, is, I am satisfied, untenable. Under the pressure of the Great Mutiny of 1858, the Indian Government brought Elephants by sea, from Pegu and the adjoining Tenasserim provinces, to Calcutta, but none from Ceylon. The occurrence up to that time was so rare there, that the debarcation of the animals, slung through the air, was figured in the "London Illustrated News" of the day as a remarkable event. Young Elephants are, I believe, never imported from Ceylon to Calcutta ;* and "Choonee" was exported thence as a very young animal. Ceylon Elephants are exported to the adjoining peninsula; but they are commonly reserved for the priests of the pagodas, for the Chiefs of Southern India, and for the commissariat demands of the Madras and Bombay Presidencies. I doubt if the Ceylon Elephant could endure the winter cold of the North-Western Provinces, exposed in the open air. I have been on the back of an indigenous Elephant, in the valley of Deyrah, in the North-Western Provinces, which is constantly resorted to by herds of the wild animal, when the thermometer stood before sunrise at 22° Fahr.: and Sir Andrew Waugh informs me, that during the measurement of the base-line for the Trigonometrical Survey, in Chuch, the temperature fell to 15° Fahr., with Elephants in the camp, exposed to the open air.

On a review, therefore, of the whole case, the evidence in every aspect, appears to fail in showing that the Elephant of Ceylon and Sumatra is of a species distinct from the Continental Indian form. Having had opportunities of observing the animal along a range of habitat, which rarely fall to the lot of a single naturalist, I have felt called upon to express an opinion on the moot question. These embraced a residence during many years at Suharunpoor, in lat. 30°, near the extreme northern range of the species; close to jungles where wild Elephants abound, and which my duties led me frequently to explore. In 1832, I was present at the 'Koom,' or great Religious Fair, which takes place at Hurdwar, on the Ganges, after each cycle of twelve years.†

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the evidence adduced above, of the numerical variability in the living species. Nor can I assent to the inference founded upon it, that the "Mastodons form not a di-"verging, but a parallel series with the Elephants." The Indian fossil species, which have been ranged under the designation of *Stegodon*, establish, through their molar teeth, a manifest and nearly unbroken passage from the Mastodons into the true Elephants. (Vide Quart. Journ. Geol. Society, 1857, Vol. xiii. p. 314.

* Mr. Blyth, in a late number of the "Journal of the Asiatic Society of Bengal," received since the above remarks were made, confirms the statement. By a return received from the Military Commissariat Office, at Calcutta, it appears that 826 Elephants were imported there, from Moulmein and Rangoon, in the years 1857 to 1859. "No Elephants," (it is added) "were received at Calcutta from Ceylon." A communication from Col. Phayre, mentions that in the seventeen months, from Dec. 1857 to April, 1859, no fewer than 1034 Elephants were shipped from the same ports to Madras and Bengal. Showing the vast number of Elephants occurring in the forests of the Trans-gangetic Provinces, and the adjoining districts of Siam. (Op. cit. 1862, No. ii. p. 174.)

† 'Kumbha Mela.' Duodecennial, when Jupiter is in *Aquarius*, and the sun entering into *Aries*. (Vide Raper. Asiat. Research. Vol. xi. p. 456.)

Vast multitudes of devotees, and others of all ranks and castes, and of both sexes, assemble there from the most remote parts of India and the surrounding countries, all the wealthiest classes bringing Elephants with them.* On that occasion I endeavoured, through the native officers connected with the administration of the Fair, to ascertain the number of Elephants then crowded within a small area, and the return made was about eleven hundred, derived from all parts of India, the majority of which passed under my eye. I have seen the Elephants of Pegu and Siam in the forests of the Tenasserim Provinces, and the Ceylon Elephant in its native island. The only geographical forms of the Asiatic species which I have not examined alive, are those of Cochin-China, Borneo, and Sumatra. The result of this range of observation, combined with long osteological study, has been to establish the conviction in my mind, that there is but a single species of Asiatic Elephant, at present known, modified, doubtless, according to his more northern or southern habitat, but not to an extent exceeding that of a slight geographical variety.

It is the more necessary that the subject should be thoroughly investigated, since upon the hasty assumption that the Elephant of Ceylon and Sumatra belong to a distinct species, a speculation has been put forward, which seeks to explain it, by means of a former direct continuity of land, between the two islands.† But the inferences of physical geography and of geology are alike opposed to the conjecture. The range of low hills which forms the spine of the Malay Peninsula, and which is separated by a narrow interval only, from the Islands of the Archipelago, can be traced north, increasing in height and development till it joins on with the Himalayah. While Ceylon, as has often been remarked, presents all the physical characters of being a severed portion of the distinct mountain-system of the Western Ghats. With certain exceptions, the Mammalian fauna, as a general rule, confirms this view, as do, also, recent investigations on the Flora of the mountainous regions of the adjoining Indian Peninsula, near its extremity. That a connexion formerly, and at no very remote epoch, existed between the Malay Archipelago and the contiguous main land, is clearly indicated by the species of the large Mammalia common to both, including *Rhinoceros Sumatranus*, *R. Sondaicus*, *Bos Sondaicus*, *Tapirus Malayanus*, *Styloceros Muntjac*, *Næmorhædus Sumatrensis*, *Ursus Malayanus*, &c., the majority of which range as far north as Pegu, or further.* That the Indian Elephant should have participated in the same common range, is thus relieved from any plea of improbability; while the speculation that Sumatra was in direct continuity with Ceylon within the period of the existing fauna, is beset with unsurmountable difficulties. In the view here taken it is also needless, since the species may have spread southwards, from a common centre, on both sides of the Bay of Bengal, and on its eastern shore into the promontory which formerly forked the Indian Ocean. The speculation here contraverted, appears to rest upon grounds as fallacious as those which led Blainville, mainly upon spurious Proboscidian evidence, to conjecture that Australia was formerly a dependency of the American continent.†

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* General Hardwick, who was present at the 'Koom' Fair of 1796, estimates the number of human beings then assembled, to have exceeded two and a half millions! doubtless an exaggeration. Five hundred devotees of one sect were killed in an affray by the Seiks. I do not vouch for the accuracy of the number of Elephants, reported to me, on the occasion above referred to; but I believe it to have been under the truth, rather than above it. I mention this, the more especially, as probably no such assemblage of Elephants will ever again be seen at Hurdwar. The facilities of railway travelling will relieve the Princes of Southern India, such as Travancore and Tanjore, &c., from the necessity of taking a cortège of Elephants with them, when they attend the Koom Fair in future. (Hardwick, *Op. cit.* Vol. vi. p. 312.) During the 'Koom' of 1760, eighteen thousand Bairagis (Fakirs of one sect) are said to have been slaughtered by the Gosains, another sect. *Op. cit.* Vol. xi. p. 455.

† Tennent. 'Nat. History of Ceylon,' 1861, pp. 61-67.

§ 10. Asserted occurrence of Mastodon in Australia.

Next to the *Equidæ*, the Proboscidians are among the most cosmopolitan and widely distributed of Ungulate Mammalia. *Dinotherium* occurs alike in the Miocene deposits of India and Europe; while species of Mastodon and Elephant, extinct and living, have been found over the whole surface of Europe, Asia, and Africa, and in both divisions of the American Continent. On the other hand, as has often been remarked before, Australia has a living fauna, so low and backward in the scale of organization, that it has struck those who have reflected on it, in the light of being an arrested fragment of an older world, in which progress was suspended, whilst in the other continents it was being steadily sustained, by the appearance of higher and higher forms. With the exception of the Dingo, which is believed to have accompanied man,* and of a certain number of indigenous Rats, the existing mammalian fauna of Australia is exclusively restricted to marsupial forms. The extinct fauna, which has been so ably investigated by Professor Owen, so far as it goes, bears the same character. The colossal *Diprotodon* and *Nototherium*, with the carnivorous *Thylacoleo*, have died out, and the giant Kangaroos,

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* Cantor. 'Journ. Asiat. Soc. of Bengal,' 1846, Vol. xv. p. 275.

† Ostéographie. 'Dinotherium,' p. 50.

* Prof. McCoy, in a recent comparison between the ancient and modern natural history of Victoria, states that he had identified remains of the *Canis Dingo* in the bone-caverns lately opened beneath the basalt-flows at Mount Macedon. They were found associated with those of *Macropus Titan*, and of recent species of *Hypsiprymnus* and *Hydromys*. He infers from this and other arguments that the *Dingo* is an indigenous animal. But there is no evidence that man may not have then been an inhabitant of Australia, and the *Dingo* introduced along with him. The latter still stands out, a symbol of isolation. (Annals and Mag. of Nat. Hist. 1862, 3d Ser. Vol. ix. pp. 145, 147.)

&c., have dwindled down into their small-sized living representatives. But except in bulk, and in the extinction of certain types, there is no indication that the modern fauna has degenerated from a higher to a lower grade of organization. To this general rule there is only one asserted exception, which, however, is of a very important order, being the so-called *Mastodon Australis* of Prof. Owen. I have long entertained doubts regarding the authenticity of the solitary molar tooth, upon which the conclusion mainly rests. These I have already advanced in an abridged form;* but as the assertion has since then been repeated by its author, it is full time that the case should be either established or confuted, more especially as the asserted exception, coming forth under the authority of so eminent a name, has been commonly adopted by Palæontologists.

In 1843, Professor Owen published the description and figure of a fossil femur of large size, discovered by Sir Thomas L. Mitchell in Darling Downs, S. W. of Moreton Bay, in Australia.† It was compared with the corresponding bone of *Mastodon giganteus*, and inferred to be of a Mastodontoid quadruped. But a perfect femur of *Diprotodon Australis*, acquired within the last few years for the British Museum, along with an entire cranium and other fine remains, places it beyond doubt, that the Darling Downs specimen, now preserved in the Museum of the College of Surgeons, is of the Marsupial *Diprotodon*, and not of any Proboscidian form.

In the following year (1844), the same author published a figure and description of 'a fossil molar tooth of a Mastodon discovered by Count Strzlecki in Australia,' which he provisionally named *M. Australis;* and he describes it as bearing a close resemblance to the molars of *M. angustidens* of Europe.‡ In his report 'on the Fossil Mammalia of Australia,' communicated to the British Association in 1844, the following paragraph occurs:

"I cannot conclude, without adverting to the singular exception "which the Mastodon forms to the continental localization, not only "of existing, but of Pliocene and post-Pliocene extinct genera of "mammalia above briefly dwelt upon. The solitary character of the "exception helps rather to establish the generalization, at least I "know of no other extinct genus of mammal which was so cosmopo-"litan as the Mastodon. It was represented by species for the most "part very closely allied, if actually distinct, in Europe, in Asia, in "North and South America, and in Australia; it is the only abori-"ginal genus of quadruped in that continent which was represented "by other species in other parts of the world."§ Here is an exception, the importance of which, if sound, can hardly be overrated, in reference to the laws which governed the distribution of the extinct mammalia of the Australian continent. The identification upon which it rests has not yet been withdrawn, so far as I am aware, by the author; and in his inaugural address to the British Association at Leeds. he re-affirms it twice, in the remarks upon the geographical distribution of animals.* As Professor Owen has not published others, it is presumed that the evidences there referred to are derived either from the remains received from Sir T. L. Mitchell, or from the molar tooth brought by Count Strzlecki. The former being of Diprotodon, the *onus probandi* now rests with the latter, which, also, is preserved in the Museum of the College of Surgeons. The specimen consists of a very perfect and intact germ of a back molar. The enamel shell is completely formed, but the pulp-nucleus had only been partially calcified, so that the ivory is limited to a thin layer below the enamel, and upon which the re-entering angles of the transverse ridges are distinctly visible underneath. No part of the ivory base, or fangs, had been formed, nor is any trace of cement visible upon the crown-surface. The specimen is entire, with the exception of a slight fracture at the top of the inner tubercle of the front ridge, which is decurrent to the base in a vertical fissure of old date, being filled up with matrix. The tooth is the penultimate true molar (m. 2.) of the lower jaw, left side; the crown is composed of three very distinct transverse ridges, divided in the longitudinal direction by a distinct bipartient fissure into an outer and inner division, each composed of a pair of high and obtusely conical thick points. The outer division of each ridge throws out, both in front and behind, a solitary outlying tubercle, attaining a lower elevation than the principal points. These tubercles, of the contiguous ridges, are connate, so as to form a bridge connecting each outer pair of mammillæ and blocking up that part of the valley which lies between them, while the inner pair of points, belonging to each ridge, is free from accessory tubercles, thus leaving the portion of the dividing valleys, between the inner points, open. A small anterior talon, running outwards, descends around the base of the outer tubercle of the front ridge, and a larger posterior talon, composed of two or three tubercles, is appended to the posterior end of the outer division of the last ridge, but free from any connexion with the inner division of the same ridge. The tooth, therefore, belongs to the subgenus *Trilophodon*, and to that section of it which may be characterised by '*Colliculi obtusi, valliculæ interruptæ.*' The necessary consequence of the form of the crown, as above described, is that in the progress of wear, when the ridges are ground down, the outer pair of points with its outlying appendages, must yield a trefoil or complex pattern to the disc of abrasion; while the inner pair, being simple, would yield an elliptical and transverse disc, free from any complication. This is the character which distinguishes *Mastodon Andium* from *Mastodon Humboldtii.* As these species are but imperfectly known in England, and one of them still more imperfectly represented by specimens, a few remarks upon them may not be considered out of place on the present occasion. Although these names were vaguely imposed by Cuvier, we are indebted to Laurillard* for the first accurate definition of their distinctive characters, confirmed by Gervais, upon the fine series of remains brought by Weddell from Bolivia.† Both belong to the subgenus *Trilophodon.* In *M. Humboldtii*, both the inner and the outer divisions of each ridge are flanked by outlying tubercles, so that the valleys are blocked up, and the mammillæ being channelled vertically, a very complex pattern is yielded by the discs of wear; two trefoils are produced, separated by a cleft, somewhat as in the molars of *Hippopotamus*, or as it has been happily expressed by Gervais "Deux figures en trèfle adossées par leur base."‡ The valleys are covered with a thick coat of cement, and the lower jaw is destitute of an incisive beak. While in *M. Andium* there is but a single trefoil, accompanied by an elliptical transverse disc to each ridge; the valleys are sparingly invested with cement, and the symphysis of the lower jaw is produced into a long massive and deflected incisive beak, as in *Mastodon angustidens.* This beak, as shown by the young animal, is figured by Laurillard in d'Orbigny's Voyage; and I have seen, at Geneva, the cast of it, as presented by the adult animal. The specimen was brought by M. H. de Saussure from Mexico (antea p. 56), and the beak in this case bore the base of a very large molar on one side.§ *Mastodon Humboldtii* is found in Colombia, Buenos-Ayres, and Brazil; *M. Andium* chiefly in Chili, Bolivia, and Peru; the valley of Tarija, in particular, abounds in remains of this species. The reputed Australian molar agrees so closely with specimens of *M. Andium*, brought by Weddell from Tarija, which I have studied in the Palæontological Gallery of the Jardin des Plantes at Paris, that I have failed to detect any sufficient character by which to distinguish them.* They agree also in mineral condition, and in the dark brown glossy colour of the enamel, where denuded of matrix.

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* Quarterly Journ. Geo. Soc. Vol. xiii p. 319, Synop. Table.

† Annals and Mag. of Nat. History, New Ser. Vol. xi. p. 8, fig. 1.

‡ Op. cit. Vol. xiv. p. 268.

§ British Association Report, 1844, pp. 223, 239.

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* "I have received evidences of Elephantine species from China and Australia, " proving the Proboscidian Pachyderms to have been the most cosmopolitan of " hoofed quadrupeds." (Brit. Assoc. Report, 1858, *Address*, p. lxxxvi.)

" In the formation of these recent tertiary periods, and in the limestone caverns " of Australia, abundance of mammalian fossils have been found, and, with the exception of the single tooth of a Mastodon, every one of them has proved to be a " marsupial species." (*Idem*, p. lxxxviii.)

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* Alcide d'Orbigny's 'Voyage dans l'Amer. Méridion.' Géol. p. 144, pl. x. and xi.; and Dict. Univers. d'Hist. Natur. tom viii. p. 30.

† 'Recherch. sur les Mammifères Fosssiles de l'Amerique Méridional.' (Expédition de Castelnau), 1855, p. 14, Pl. v.

‡ *Op. cit.* p. 18.

§ Laurillard inferred from d'Orbigny's figure, that although the beak was elongated, from its tenuity there were no incisors to the lower jaw in this instance; or that, if ever present, they were rudimentary, and had been shed early in life. In the specimen figured by Dr. Wyman, showing the lower jaw of an adolescent animal, the symphysis is somewhat elongated, but blunt, and there is no appearance of its having held incisors. The possession of mandibular incisors may have been a sexual distinction. (United States' Australian Expedition, Pl. xii. figs. 1 and 2.

As regards the history of the reputed Australian specimen, unfortunately it was not seen, *in situ*, by Count Strzlecki. That enterprising traveller, whose explorations embraced North and South America, Australia, the Javanese Islands, &c., states that he "bought "it from a native at Boree, the sheep-station of Captain Ryan, "through the agency of the overseer of that station. The native, "in giving the bone, stated that similar ones, and larger still, might "be got further in the interior; but that, owing to the hostility of a "tribe upon whose grounds the bones are found, it was impossible "for him to venture in that time, in search for more," &c.† The account given in Professor Owen's paper, differs in some respects: being to the effect, that the specimen was brought by a native to Count Strzlecki when exploring the ossiferous caves of Wellington Valley;‡ and that the native stated that it was taken out of a cave further in the interior.§ But the fossil bones of the ossiferous breccias of that valley are covered with a bright coloured ochreous clay, not a trace of which is to be seen on the fossil molar, the matrix of which is of an entirely different character. Settlements have been pushed into the interior since 1843, far beyond Boree and Wellington Valley; while the country has been penetrated in various directions by exploratory expeditions. Stupendous remains of *Diprotodon* and *Nototherium*, in the finest state of preservation, have been discovered, and remains also of the very remarkable form named *Thylacoleo;* but during the twenty years which have lapsed, not a trace has been detected, so far at least as published accounts go, of anything confirming the inference of an Australian Mastodon. Where remains of the Proboscidia occur, they are commonly found in abundance; and the colossal size of the bones has led, in all ages, and in all countries, to their attracting lively attention. The absence of direct testimony, in the first instance, the conflicting statements regarding the place and conditions of occurrence, the discordance of the matrix, and the failure of subsequent confirmatory evidence, coupled with the fact of the solitary molar having been identified as being of a South American species, lay the authenticity of the specimen open to grave doubts. If an American form, how did this unique morceau get to Australia? If Australian, how has the *Mastodon* alone, of all the higher placental mammals, broken through the barriers of marsupial isolation, characteristic of the great southern island? Of the two alternatives, there are probably few palæontologists who will be disposed to seek for an explanation in the naive conjecture of Blainville, that Australia, to meet the requirements of the case, was in connexion with America within the Pliocene period.* It seems more probable that some unintentional error has got mixed up with the history of this remarkable fossil; and until further confirmatory evidence is adduced, of an unimpeachable character, faith cannot be reposed in the reality of the asserted Australian Mastodon.†

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* On the occasion, where I first questioned the authenticity of the reputed Australian Mastodon, I was led to identify it with *M. Humboldtii*, instead of *M. Andium* (*vide* Quart. Journ. Geol. Soc. 1857, vol. xiii. Synoptical table, p. 319.) On the same occasion (*op. cit.* p. 313) I called attention to the exceptional character of certain specimens of *M. Andium*, as if hesitating between *Tetralophodon* and *Trilophodon*. I believe the species will prove to belong to the latter group.

† Strzlecki, 'Physical Description of New South Wales,' &c., 1845, p. 312.

‡ Buree Creek, an affluent of the Lachlan River, is in the Ashburnham District, north of *Canobalas* Mountain; while Wellington Valley is on the Macquarie River, an affluent of the Darling. A considerable tract intervenes.

§ "It is partially mineralized and coated with the reddish ferruginous earth, "characteristic of the Australian fossils discovered in the Wellington ossiferous "caves by Sir T. Mitchell." (Annals and Mag. of Nat. Hist., Vol. xiv. p. 270).

§ 11. Food of living and extinct Elephants.

The alimentary habits of the Asiatic Elephants, in the wild and subjugated state, have been so carefully observed, that there is, perhaps, no other pachyderm with which, in this respect, we are better acquainted. But the same cannot be said of the African species; the details of the vegetable matters which constitute his staple food, are only known in a very general way, although it is certain, from the difference of the vegetation of Southern Africa, where he now exists in great force, and of Northern and Western Africa, near the foot of the Atlas, where he abounded within the historical period, that his food must vary within a considerable range of species. The teeth of the Asiatic and African Elephants are so differently modified, and the trees on which they browse are so distinct, that the Asiatic species would probably be distressed for food, where the African finds it in abundance, and *vice versâ*. Both are represented in the fossil state by species having molars constructed more or less after the patterns respectively yielded by them, and I propose to consider how far our knowledge of the former will assist us, in speculating regarding the alimentary habits of the latter.

(*a.*) *Food of the Indian Elephant.*—The 'Sal,' or 'Tarai' Forests, which stretch at the foot of the Himalayahs, from lat. 30°, where the Ganges and Jumna escape from the mountains to the Bramapootra, embracing a range of several hundred miles, are here selected to furnish the chief illustrations which I have to adduce. They everywhere abound with Elephants, southwards from lat. 30°, which may be regarded as the extreme northern limit of the habitat of the species at the present day. Forests presenting similar physical characters, extend along the continuation of the same range, through Sylhet, Chittagong, Arracan, Pegu, and the Tenasserim Provinces, to the point of the Malay Peninsula; they become more and more tropical in their vegetation, and, as a general rule, the Elephants improve in size, form, and vigour, according to their more southern habitat.

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* The fact that such a hypothesis was advanced, shows the responsibility involved in the publication of the *data*, which gave rise to it.

† Since the above remarks were written, Professor Owen, again brought forward the case of the Australian *Mastodon*, as a proof of the remarkable geographical distribution of the Proboscidia, in a communication which he delivered to the British Association at Cambridge, on the 4th Oct. entitled, "On a tooth of *Mastodon* from the Tertiary marls near Shanghai." In the subsequent discussion, he frankly abandoned it, in consequence of the doubts then urged regarding its authenticity. As the asserted fact has taken deep root in systematic works, it is still necessary, that the refutation here embodied should appear in the records of Science. (*Vide* 'Parthenon' of 11th Oct. 1862, p. 754.)

The 'Sal' Forests are densely covered with arboreous forms belonging chiefly to the folowing Dicotyledonous genera:—*Vatica, Pentaptera, Terminalia, Conocarpus, Casearia, Dalbergia, Cedrela, Buchannania, Semecarpus, Boswellia, Spondias, Odina, Garruga, Cathartocarpus, Bauhinia, Butea, Erythrina, Acacia, Robinia, Moringa, Kydia, Sterculia, Bombax, Grewia, Murraya, Glycosmis, Citrus, Nauclea, Hymenodictyon, Rondeletia, Schrebera, Eugenia, Careya, Ulmus, Gmelina, Premna, Emblica, Röttlera, Briedelia, Ehretia, Tetranthera, Cordia, Wrightia, Holarrhena, Antidesma, Putranjiva, Grewia, Trophis, Cochlospermum, Batis, Diospyros, Bassia, Morus, Ficus, &c.*

But of the large number of species belonging to these genera, a very small percentage only of the aggregate mass of forms enters into the food of the Indian Elephant; the reason of this being, that some of the species, such as the 'Sal' (*Vatica robusta*), and other predominating trees which extend for miles, nearly to the exclusion of other trees, contribute nothing to the aliment of the animal. In fact, the range of his arboreous selection is restricted within a narrow circle, and mainly to the foliage and branches of trees that abound in milky juice which is not acrid, belonging to the families of the *Moreæ, Artocarpeæ*, and *Sapotaceæ*, such as species of *Ficus, Batis, Artocarpus, Bassia*, and *Mimusops.** Of these, by far the greater part of his staple food is derived from the colossal fig-trees which abound in the forests of India; such as *Ficus Indica*, the 'Bur,' or 'Banyan-tree; *F. religiosa*, 'Peepul,' or 'Bodhi-drooma,' (Tree of knowledge); *F. venosa*, 'Pilkhun;' *F. cordifolia*, 'Gujeena,' or 'Assoud;' *F. glomerata*, 'Goolur;' *F. Tsiela*, 'Kuth-bur;' and in Assam, *Ficus elastica*, or the 'India-Rubber tree,' besides other more southern species of similar habit and properties. The strong partiality of the Elephant for these trees is so well known to the natives, that the '*Obees*,' or Pit-falls, for entrapping the animal are invariably constructed in their neighbourhood, and many of their old Sungscrit names connect them specially with the Elephant.† He tears down their branches, and crunches the twigs and leaves, stripping off the lactiferous bark of the larger boughs. The Elephant of the 'Sal' Forests also derives occasional food from the foliage and fruit of *Artocarpus Lakoocha*, 'Dhao;' *Batis aurantiaca*, 'Puneeala;' *Bassia latifolia*, 'Muhowa,' and among others from the fruit of *Feronia Elephantum*, 'Kuth-bel;' *Ægle marmelos*, 'Bel;' *Diospyros tomentosa*, 'Teindoo;' and in the Southern Forests, from the huge induviated fruits of certain species of *Dillenia*, *&c.* Of aliment derived from the roots of Dicotyledonous trees and shrubs, such as the African Elephant is said to affect, I know of but one form in the 'Sal Forests' which the Indian species is known to touch, namely, the huge tuberous dilatation of the ligneous root of the Scandent, *Pueraria tuberosa*, 'Sural.' The fruticose and herbaceous Dicotyledons, the foliage and stems of which may enter into his occasional food, I do not attempt to enumerate.

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* Also *Mesua ferrea*, (Nat. Ord. *Clusiaceæ*) on the authority of Tennent's Nat. Hist. of Ceylon, p. 230.

† 'Nagbhundoo,' 'Koonjurashun;' 'Gujashun,' and 'Gujbhukshuk;' all being to the effect of 'food of Elephants.' (*Vide* Madden. Journ. Asiat. Soc. Beng. Vol. xvii. p. 380.

Among the Monocotyledonous families, a very large portion of his habitual fare, is derived from the *Gramineæ*, and more sparingly from Palms; of the former, he luxuriates on the young shoots and tender foliage of various species of Bamboo, which occur in vast abundance, together with the fleshy albuminous fruit of *Beesha Rheedii*, found in the southern forests. The 'jheels,' or swamps, to which he resorts, are sheeted with the gigantic reeds of *Arundo kurka*, '*Nul*,' the young culms of which, together with the stems and leaves of *Typha Elephantina*, 'Patela,' at certain seasons, constitute a favourite food of the Indian Elephant. The open glades and prairie lands are covered with species of *Saccharum*, forming what is called 'Grass Jungle,' composed chiefly of *S. spontaneum*, 'Kas,' interspersed with *S. fuscum*, 'Tat,' *S. Sara*, '*Surkura*,' or, 'Moonj,' *S. exaltatum*, 'Suroo,' &c. Clumps of these grasses are twisted up by his trunk, in his journeys to and from the forests; they are beaten against his legs to free the roots from sand, and then subjected to mastication. The sand which still adheres to these grasses, together with the large quantity of silica contained in the leaves and culms of *Saccharum spontaneum*, the most characteristic species of the grass jungle, perform an important duty in the economy of wear of the Elephant's molar teeth.* Palms, which are stated to occupy the first rank in the favourite food of the animals in Ceylon,† are represented in the 'Sal' Forests by species which either do not, or hardly at all contribute to it: being limited to *Calamus Roylei*, *Phœnix acaulis*, and *Harina oblongifolia*. But in the more southern forests they are replaced by various genera and species, the tender and farinaceous leading shoot of which, as in Ceylon, is eagerly eaten by the Elephant. But compared with the wild fig-trees, bamboos, and other grasses, they constitute a subordinate part only of the food of the wild animal. When he makes a raid into cultivated tracts, he commits great havock upon sugar cane, rice fields, plantains, and many other cultivated plants;* but these incidents form only interludes in his established alimentary habits. His dung in the wild state, commonly presents a large proportion of contused and undigested woody fibre, in a stringy form, mixed up with other vegetable tissues.

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* The excessive abundance of silica in the culms and leaves of *S. spontaneum*, is practically shown, when it is attempted to mow it with an English scythe. After a few sweeps with the implement, the edge is rounded off, as I have repeatedly witnessed.

† Tennent, Nat. Hist. of Ceylon, p. 230.

It is difficult to conceive of a mechanism better adapted to the duty which they have to perform than is presented by the molars of the Indian Elephant. Taking the three true molars, which serve during the adult stage of the animal, they are composed successively of 12, 16, and 24 ridges. Each ridge has the core formed of a high wedge-shaped plate of ivory; a continuous plate of enamel is closely folded over these wedges, which are confluent at their base; and the intervals between the ridges are filled up, each with a reversed wedge of cement, which is insinuated between the grooves and inequalities of the enamel. When the crown is in full activity of wear, the penultimate molar, consisting of sixteen ridges, presents an unequal triturating surface, composed of thirty-two plates of enamel, alternating with sixteen thin wedges of ivory and as many of cement, making in all sixty-four alternations, disposed within a length of from 8½ to 9½ inches. The disintegrating and bruising power of the surface is further greatly augmented by the circumstance, that, in the Asiatic Elephant, the plates of enamel are folded vertically into a number of bold close-set zig-zags, or undulations, which present a crimped edge during wear. If a number of these plates were brought together, so as to place their undulations in contact, an appearance would be produced, analogous on a large scale, to the engine-turning of a watch-case, arranged in longitudinal lines. The three constituent materials being of unequal hardness, the cement is worn lowest, the enamel highest, and the ivory to a level between the two. A constant equilibrium is maintained, in the normal state, between the nature of the food, the waste of the crown-surface, the absorption of the fangs, the forward movement of the body of the tooth, and the replacement of the worn out portion by a succession of fresh plates, protruded from behind.

This goes on in the wild state, but no sooner is the animal kept in captivity than the balance is upset, and the whole mechanism put out of gear. Instead of grass culms and leaves charged with silicious crystals, or mechanically mixed with sand, and of tough woody fibre and bark, requiring a powerful process of trituration to fit them for deglutition, the animal is supplied with concentrated cereal food and hay, with an admixture of nutritious roots and mashes, or green fodder. The consequence is, that the crowns of the active molars do not get worn down with sufficient rapidity to make way for the tooth forming behind, and abnormal or morbid results follow:—

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* Corse, Asiat. Research. Vol. iii. p. 229.

1st. The used surface of the crown, instead of being unequal and terraced, is worn smooth and flat, in some instances even, like a slab of polished marble.

2nd. The uncalcified back portion of the capsule of the tooth in action, instead of remaining distinct, becomes, from the undue pressure behind, united with the formative capsule of the contiguous back tooth, the development of which is not retarded, and the two separate molars are fused into one unwieldy mass, covered by a continuous shell of cement. A fine example of this state is presented by an adolescent cranium in the Museum of the College of Surgeons, (No. 2665, Osteol. Cat.) in which two molars, and apparently part of the third in front, are united into one; and the pressure has, besides, acted so as to contract the palate, and bring the opposite molars nearly into contact in front.

3rd. The anterior fangs of the tooth in action are gradually absorbed, while the corresponding portion of the crown remains unworn, and is projected forwards, like a foreign body, beyond the edge of the alveolus. I observed a very remarkable instance of this morbid condition in the cranium of a 'Mukna' Elephant, preserved in the Natural History Museum at Florence. On the right side, in this specimen, there are three molars *in situ*: the last in germ, the penultimate partly worn, and agglutinated to it in front, the extruded body, without fangs, of the antepenultimate, which is projected forwards and upwards across the diastemal interval, so as actually to press against the palatine floor of the maxillary bones. In this case the morbid pressure had caused the absorption of the plate of bone forming the base of the sheath of the incisor, which is indicated by a deep pit, and it probably led to the death of the animal, with great torture.

4th. The capsule of the last molar being constrained for room, by the undue resistance in front of it, there is not sufficient space for the normal arrangement of all the plates as they are successively calcified, and the hindermost become distorted in position. A fine example of this malformation is presented by the last lower molar, fig. 90, of the 'British Fossil Mammalia.'* The tooth is there described, as being of the Mammoth, but it is in reality a molar, disguised and blackened by smoke, of an Asiatic Elephant, which had died in captivity. The back plates, in this case, are pressed and crowded upwards so as to have become nearly horizontal. Similar instances are figured by Blainville,† without his having been aware of the nature and cause of the distortion.

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[*] *Op. cit.* pp. 226 and 233, and Cat. Foss. Mam. &c. Coll. of Sur. No. 567, p. 134. It is the more necessary to make the rectification here indicated, since the figure has been copied by an eminent French Palæontologist, on the authority of the work, as a characteristic specimen of *E. primigenius*. *Vide* Mémoires Acad. Montpell. tom. i. p. 423, Pl. xv. fig. 9.

[†] Ostéographie, Éléphant, Pl. vii. fig. 6, and Pl. x. fig. 6.

The Elephants kept in the menageries in Europe are all, more or less, in this morbid condition of the dental system. They are fed on rations composed largely of turnips, carrots, mangold-wurzel, and of mashes of boiled rice, bran, sea-biscuit, and chaff, &c. The only hard and dry food issued to them, consists of a truss or two of hay, and the straw used for their litter. Ligneous food, such as they partly live upon in the wild state, is denied to them, and the results are so certain, that one can anywhere point out in a museum, the molar of an Elephant which has been kept in captivity. For obvious reasons, the effects, although still discernible, are less pronounced in the molars of Elephants which have been retained in bondage in their native country.

The bearing of these observations upon the normal condition of teeth of the Mammoth, and its inferred alimentary habits, will be shown in the sequel.

(*b.*) *Food of the African Elephant.*—The alimentary habits of the Indian species are so well known, simply from the fact, that being tamed, one can observe from his back, in beating through his native jungles, every thing which he selects, and all that he passes by. The same close observation can not be applied to the African form, as, at the present day, he is nowhere in his native continent trained for the use of man. Our knowledge of his food is, therefore, of a vague and general character, being derived from the cursory observation of travellers, whose attention was not specially directed to the subject.

The molar teeth of the African Elephant are intermediate, in construction and triturating characters, between those of the *Euelephantes*, or Elephants Proper, and the fossil *Stegodons*. They present, in the three intermediate and last molars for the ridge-formula, the successive ciphers 7 : 7, 8, 10 ; while *E. antiquus*, presents the ciphers 10 : 10, 12, 16, and *E. primigenius* and *E. Indicus*, 12 : 12, 16, 24. The aggregate of the series of ridges in the first amounts only to 32 ; in the second to 48 ; and in the two last to 64 ; involving a great difference in the triturating mechanism of the teeth. In the African form the molars are also shorter, narrower, and of less elevation, than in the Asiatic species. The discs of wear, instead of the narrow transverse bands seen in the latter, exhibit the well-known rhomboidal expansion characteristic of the species. Instead, therefore, of being adapted to contuse and triturate the branches and twigs of trees, they are better suited for squeezing and crushing leaves, and succulent stems or roots. The habits of the animal, as observed by travellers, are in accordance with these indications. Besides browsing on the foliage of the Mimosas and Acacias, which abound in Southern Africa, they tear up the trees of certain species of these genera by the roots, aided, according to Pringle, by their tusk, used as a crowbar (?), and they devour the succulent parts of these roots in the inverted trees.* Burchell mentions a small species of *Prosopis*, *P. Ele-*

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* Cited in the 'Library of Entertaining Knowledge.' Menageries, Vol. ii. p. 36.

phantorhiza, as yielding a favourite food to the Elephant;* and the succulent 'Spekboom' *Portulacaria Afra*, or 'Tree Purslane,' is noticed by most travellers as yielding another.

That the African Elephant, such as we now see it, formerly extended to the South of Europe, has been put beyond question—1st, by the researches of Lartet upon remains found in the neighbourhood of Madrid;† 2nd, by the remains discovered by Baron Anca in the cave of San Teodoro in Sicily;‡ 3rd, by a molar from Grotta Santa, near Syracuse, described by the Canon Alessi,§ and identified by myself; and lastly, by a molar exhumed by M. Charles Gaudin, in 1858, in a cave near Palermo. The last specimen has lately been transmitted to me for examination, and it proves that the African Elephant existed in that island as the cotemporary of the two extinct species of Hippopotamus of the Sicilian caves. The reputed cases of molars of the African Elephant, from the valley of the Rhine, described by Goldfuss, I believe to be spurious fossils, after having submitted them to a careful examination.|| Captain Spratt, R.N., the indefatigable explorer of the Hydrography and Geology of the Mediterranean, has, as already stated, lately discovered in Malta numerous remains of a surprisingly small fossil Elephant, of the sub-genus *Loxodon*, which I have named *E. Melitensis.*

Of the more ancient European fossil species, *E. antiquus* is that which most resembles the African Elephant in the mesial expansion of the discs of its worn molars. But the character is shown in a much less degree, and the great difference in the ridge-formula of the two species, places them in two distinct sub-genera. *E. antiquus*, in the series, is intermediate between *E. Indicus* and *E. Africanus*, but more nearly allied to the former. The crowns of its molars indicate alimentary habits intermediate between those of the two living species.

(*c.*) *Food of the Mammoth.*—In order to estimate the force and value of the arguments which have been raised on this head, it is necessary to institute a rigorous comparison between the mechanical conditions of the molar crowns of the Indian Elephant, and of the fossil species.

The ridge-formula is the same in both, being for the four last teeth of the upper jaw 12 : 12, 16, 24. The number of ridges in the three first of these is very constant; the last, as already stated, is variable within certain limits, twenty-two being the most common

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* *Acacia Elephantina*, Burch. 'Travels in South Africa,' Vol. i. p. 236. *Elephantorhiza Burchellii*, Benth.

† Comptes Rendus. 22 Fèv. 1858. Tom. xlvi.

‡ Bullet. Soc. Géol. de France. 2 Sér. t. xvii. p. 684. Pl. xi. figs. 5 & 6.

§ Atti dell' Acad. Gioenia di Scienz. Natur. tom. 7. p. 223.

|| Nova Act. Acad. Natur. Curios. tom. x. pl. xliv. and tom. xi. p. 2. pl. lvii., fig. 1. A specimen of a reputed fossil molar, of *E. Africanus priscus*, in the Museum of Rudolstadt (Schwarzburg), direct testimony to the authenticy of which was borne by the finder, when the case was investigated on the spot by Sir Charles Lyell, proved, on examination in London, to be of a recent African Elephant.

number. Taking the penultimate, as in the case of the Indian Elephant, the worn surface of the crown would show sixty-four alternations of unequally hard materials.

Although agreeing in this essential respect, there are important differences in the mechanical disposition of the plates. In *E. primigenius* the molars are shorter for the number of their constituent ridges, and their crowns are also, both absolutely and relatively, broader than in the Indian species. The alternate successions of cement, enamel, and ivory, are therefore more attenuated and more condensed, and a larger number of them enter into the surface of that part of the tooth which is in wear. Lartet fixes the number of ridges that may be in active use at from twenty to twenty-three in a length of about 9½ inches (0.24 met.); while in the adult Indian Elephant the number of bands in the same length is usually about sixteen. But the great difference lies in the mechanical properties of the enamel plates. Instead of being thick and robust, with close-set and regular undulations, or zig-zags, as in the Indian species, they are thin and parallel, the projecting edges running either straight across, or if there is a tendency to undulation, it is but slight, fine, and inconstant; occasionally, even, there is irregular angular expansion, or flexuosity in the edges of discs that are worn low down; but, as a general rule, the plates are straight, and free from waviness. It is this character which involves the greater width of the molar crowns in the Mammoth: if the undulations of the Indian Elephant were unfolded, the crown-plates would in that species be as broad as on the fossil one. Another difference is, that these plates are higher in the Mammoth. In the Texan specimen of an upper molar, mentioned above (p. 58), they attain the enormous height of nearly eleven inches.

The triturating surface of the crown in the active molar presents another and very significant difference. Instead of the terraced inequalities, seen in the molars of *E. Columbi* and *E. Indicus*, as described above, the worn surface in the Mammoth is nearly flat; the enamel-edges rising but a very little above the ivory and cement. This is a constant character of Mammoth-molars of all ages, and of all regions, whether from the pre-glacial 'Forest Bed' of the Norfolk coast, from the volcanic gravels around Rome, from the superficial gravels of England, from the frozen soil at the mouth of the Lena, from Eschscholtz-bay, from the swamps of the Ohio, or the prairie lands of Texas. In fact, the normal condition of the molar crown of the Mammoth resembles that of the Indian Elephant, which has been fed in captivity, but without the distorted arrangement of the plates seen in the latter. This observation, so far as I am aware, has not been made before; and the fact will explain the reason why I have entered so much in detail into the cause of the unnatural condition in the captive Asiatic species.*

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* The distorted condition of the molars of the subjugated existing species, is occasionally seen, although very rare, in the teeth of the Mammoth. A fine example

What, then, was the nature of the food of the Mammoth? In speculating on this question, we have for our guidance—1st, the mechanical properties of the molar crowns as a disintegrating apparatus; 2nd, the analogy of the living species; 3rd, the climate and implied vegetation of the habitat of the extinct animal.

Regarded as an instrument for crunching and contusing the woody fibre and tough bark of trees, the crown of the molar in the Indian Elephant is manifestly much more powerful than that of the Mammoth. The elements which determine the ratio of force in the comparison, are the strength, projection, and number of the enamel edges, the ivory and cement being, in the mechanical aspect, but the setting in which the plates are fixed. In the molar of the Indian Elephant, they are like the edges of thick plates of corrugated iron, having a considerable amount of relief; while in the Mammoth they are like the edges of thinner flat plates of the same metal, barely elevated above their level setting, but more numerous, in the same extent of grinding surface, in the ratio of 5 to 4. In the former, the tough and ligneous matter which it is known to select for its food, tell upon the triturating elements, as might be predicated, in the ratio of their densities. The soft cement is worn lowest, the plate of ivory forms a depressed band, and the enamel plates project over both—the wider intervals by which they are separated contributing to facilitate the mechanical result required in the case. In the Mammoth the plane of the setting remains flat, and the enamel-edges are but slightly in relief above it. The molar in the palate of a Mammoth from Eschscholtz-bay, in the Palæontological gallery of the British Museum, may be cited in illustration. If hard woody fibre entered more largely into the food of the fossil than it does into that of the existing species, it is difficult to conceive why corresponding mechanical results should not have followed, in the greater proportional erosion of the cement.

It has been argued, and the reasoning has met with very general acceptance,* that "if we find in an extinct Elephant the same peculiar principle of construction in the molar teeth" (*i.e.* as in the living forms), "but with augmented complexity, arising from a greater "number of triturating plates, and a greater proportion of the dense "enamel, the inference is plain, that the ligneous fibre must have

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is presented by a last true molar of the upper jaw, preserved in the Woodwardian Museum of Cambridge, in which the five last plates are contorted and crowded on one side. It might serve for the molar of a Mammoth which had been in bondage to man of the early 'Flint-knife' period. But a natural cause of this condition is intelligible, on the supposition that the molar which preceded it was not opposed by a corresponding tooth in the lower jaw; a deficiency which is known to occur, from disease or accident, both in living and extinct forms.

* The deduction here referred to has been adopted by the distinguished authors of the 'Geology of Russia,' in their disquisition on the '*Habitation and Destruction of the Mammoths*,' with a very high estimate of its importance, as a result of palæontological research. *Op. cit.* Vol. i. p. 497.

"entered in a larger proportion into the food of such extinct species."* But there are objections to the terms here used, as accurately expressive of the difference, which are opposed to the inference. It is true that there is a greater number of thinner enamel-plates, in the same extent of triturating surface, which thus becomes more *composite;* but it is not so that there is a greater proportion of dense enamel, nor that the crown is more *complex.* The greater thickness of the plates in the Indian species compensates for their more frequent repetition in the fossil form; while their strong undulation in the former necessarily renders the grinding surface much more complex than in the latter. Let any one look at the beautiful figure of the molar crown of the Indian Elephant in the British Fossil Mammalia, cut 90, p. 233, and compare it with cut 92, p. 237, of the Mammoth; the contrasted differences are obvious at a glance. The latter is a mechanism for finer disintegration; but the former, from its conjoint properties of greater strength, complexity, and inequality of surface, is a more powerful apparatus for crushing and contusing hard ligneous fibre.

For these reasons I cannot assent to the soundness of the asserted physiological inference, that a coarser kind of vegetable food, and a larger proportion of ligneous fibre must have entered into the subsistence of the Mammoth than do into that of the living Asiatic species, or that there was any necessary relation between the peculiar structure of its teeth and the subarctic arboreous vegetation of Siberia, seeing that the same structure holds in the molars of the pre-glacial Mammoth of the Norfolk coast, and in that of Central Italy. Professor Owen has taunted the great observers who preceded him, with having failed to follow up the inquiry regarding the Siberian Mammoth to its legitimate consequences:—

" It might have been expected that the physiological consequences " deducible from the organization of the extinct species, which was " thus, in so unusual a degree, brought to light" (*i.e.* the Adams " Mammoth), " would have been at once pursued to their utmost legi" timate boundary, in proof of the adaptation of the Mammoth to a " Siberian climate; but save the remark, that the hairy covering of " the Mammoth must have adapted it for a more temperate zone than " that assigned to existing Elephants,† no further investigation of the " relation of its organization to its habits, climate, and mode of life " appear to have been instituted; they have, in some instances, indeed, " been rather checked than promoted."‡

It is certainly unexpected to see it insinuated that it was left to Pictet to point out, in 1844, that the long hair of the extinct species

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[*] Brit. Foss. Mamm. p. 268.

[†] " La longue toison dont cet animal était couvert, semblerait même démontrer, " qu'il était organisé pour supporter un degré de froid plus grand que celui qui con" vient à l'éléphant de l'Inde. Pictet. Palæontologie, 8vo. tom. i. 1844, p. 75."

[‡] British Fossil. Mamm. p. 267.

appeared to fit it for sustaining a greater degree of cold than that which the Indian Elephant now bears. Nearly a century ago, Pallas threw out the same conjecture regarding *Rhinoceros tichorhinus*, upon the hair with which it was covered; while Cuvier expressed his opinion on the subject with characteristic precision ; after describing the nature of the hair of the Mammoth, he adds: " par conséquent, " il n'est pas douteux que l'éléphant fossile, *tel qu'il se trouve en Si-* " *berie*, avait une fourrure d'animal de pays foids."* Again : " Ainsi non seulement il n'y a rien d'impossible à ce qu'elle ait pu " supporter un climat que feroit perir celle des Indes, il est même " probable, qu'elle 'etoit constituée de mamère à preférér les climats " froids."† Here it will be observed that Cuvier, with philosophic caution, limits his argument to the extinct animal, such as it occurs in Siberia, believing, as he did, that the species had also existed in more temperate regions. But we now know that the Mammoth roamed over Europe before the Glacial period. Take the cases where its remains have been found in the 'Forest-bed' of the Norfolk coast, and in the volcanic gravels around Rome. In the former, the vegetation, arboreous and herbaceous, according to the determinations of Heer, closely resembled that of the existing period, and the preglacial Mammoth subsisted upon it, in association with *Elephas antiquus*, *Hippopotamus major*, and *Rhinoceros Etruscus*. The valley of the Tiber, between the Seven Hills, was formerly a great lake,‡ more than 130 feet above the present level of the river, receiving the volcanic ashes and other *ejecta* of the surrounding active craters, and forming enormous beds of travertine, and gravels in which remains of the true Mammoth occur, associated with *Elephas antiquus*, *Rhinoceros leptorhinus* (*megarhinus*, Christol.), and a species of extinct *Hippopotamus*. No one, at the present day, will be hardy enough to maintain that the Flora of Central Italy was at that time identical with, or as limited in the number of Arctic species as, that of Siberia, where the wool-clad variety of the north lived and pastured; for we have distinct proof that the glacial refrigeration, which characterised the Alpine valleys and plains of Europe north of the Alps, was greatly modified in intensity on the southern side of the chain. The enormous glacier of the valley of the Adige, after emerging from the 'Lago di Garda,' melted away, leaving on the margin of the valley of the Po a vast mass of moraine. On the southern side of the Apennines, glacial phenomena have nowhere as yet been traced down upon the plains on their flanks. Yet the Mammoth existed in Central Italy, either before that period of refrigeration began, or when its effects told, but inconsiderably, in that southern latitude. It would therefore be as legitimate to detect a special relation between the composite structure of the teeth, and the vegetation upon which they were exercised, in the Mammoth of the South of Europe, as in the asserted case of the Mammoth of Northern Asia.

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* *Oss. Foss.* 4to Edit. tom. i. p. 196.

† *Idem*. p. 200.

‡ Hoffmann, Edinb. New Philos. Journ., 1829, Vol. viii. pp. 85 and 96.

Again, let us take the case of the Mammoth of Texas, and of the other Southern States, bordering the Gulf of Mexico. It will hardly be asserted, at the present day, that the same arboreous vegetation extended from the upper parts of the valleys of the Obi and Irtish across northern Asia, and from Behring's Straits across the surface of North America to the warm latitude of the Gulf of Mexico. Granted that the refrigeration of the Glacial period extended so far south, it must have been greatly modified in intensity by the southern latitude, as it was in the south of Europe; and that modification was incompatible with a tree vegetation restricted to pines, birches, poplars, willows and junipers. We further know, that when the Mammoth pastured along the margins of the great swamps of Ohio and Kentucky, vegetation then was nearly identical with what it is now, being very different from that of Siberia.

An inconsistency of the advocates of the doctrine here combated, is worthy of notice. While so strongly insisting on the special relation between the teeth of the Mammoth and the leafless tree-vegetation on which he fed during winter, it was asserted that the variety of molar on which *E. meridionalis* is founded, occurs not only in England but in Siberia, and as far north as Eschscholtz-bay.* It is well known that the teeth of the latter species possess characters which are very different from those of the former; having thick enamel-plates, which are few in number and wide apart. The special adaptation, between the teeth and food, which held in the one, was therefore absent in the other, although, under the view here referred to, they were both said to be found in the same Arctic localities, where they must both have subsisted on the same impoverished Flora.

The state of our exact knowledge, at the present time, regarding the duration, geographical range, climate, habits and food of the Mammoth, appears to be thus. The species existed before the Glacial period in Europe, and survived long after it in Europe or America. The constitutional flexibility, which is implied by its 'dicyclotherian' term in time, is equally evinced in its vast geographical range of habitat; extending from the valley of the Tiber to the Lena, and from Eschscholtz-bay to the shores of the Gulf of Mexico. Making due allowance for the interference of the glacial phenomena, the extremes of north and south latitude, in which undoubted remains of this ancient Elephant have been found, necessarily imply, that his constitutional flexibility was like that of man, capable of adaptation to very great differences of climate. In Siberia, he was "enveloped in a shaggy thick covering of fur, like "the Musk Ox, impenetrable to rain or cold."† But we are not obliged to suppose, that in his southern habit he was thus clad. The dermal appendages are very variable and adaptive, according to climate. The fine silky fleece, from which the Cashmeer shawls are wove, is abundantly developed at the roots of the long hairs of the domestic goat in the plains of Tibet, at, and upwards of 16,000 feet above the level of the sea, where a highly rarified atmosphere is combined with severe winter cold. It grows also, on the Kiang, the Yak, *Cervus Wallichii*, the Brown Bear of high elevations in the Himalayah, and on the Mastiff Dog of Tibet. But it disappears entirely from the same Goat, and from the Dog, in the valley of Cashmeer. The short crisp wool of the Siberian Mammoth, which seems to have been the most protective portion of his fur, may, in like manner, have disappeared from the variety that lived in the valley of the Tiber, while the bristles and long coarse hair were more or less retained; and it is in the highest degree probable, that the species presented varieties of external form, dependant on the nature of the dermal clothing, far exceeding those which are seen in existing Elephants. That the Siberian Mammoth migrated periodically, from the more southern forests, towards the Polar sea, during summer, as his surviving cotemporaries the Musk Ox and Reindeer now do, is also highly probable; * but we have no grounds to believe, that the Mammoth of Southern Europe, ever made migrations to the north of the Alps.

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* Brit. Foss. Mamm., p. 238.

† Fleming. Edinb. New. Phil. Journ. 1828, Vol. 6. p. 285.

The same constitutional elasticity, which enabled the Mammoth to endure such a variety of climates, and to spread over such a vast geographical area, necessarily extended to his alimentary habits. I have already called attention to the remarkable constancy in the specific characters of the molar teeth, alike in the pre-glacial and post-glacial, in the extreme northern and the extreme southern forms. Their adaptation was not special to the vegetation merely of Siberia, but general to that of every region over which the species spread; and up to the present time, not a plausible conjecture even, has been offered, as to the class of vegetable matters which they most affected. The question of the food of the species has not been, in the least, advanced since the discovery by Adams, of the ice-preserved carcass on the banks of the Lena in 1803, or since philosophic doubts were expressed by Fleming on the subject in 1829.† Wherever a certain result has been arrived at, regarding the alimentary habits of the extinct Mammalia of the Glacial period, it has only been by discovering the remains of the food itself in some of the organs of digestion. We have the authority of Brandt for the fact, that he extracted from the pits of the molar teeth of the *Rhinoceros tichorhinus*, of which the carcass was obtained by Pallas from the banks of the Wiljui, part of the albuminous seed of a Polygoneous plant, portions of Pine leaves, and minute fragments of Coniferous wood, characterised by the distinctive porous cells.* In like manner, four cases have been described in North America, where the contents of the stomach and intestines of *Mastodon Ohioticus* appear to have been preserved along with the skeletons; and the facts recorded by different observers, are so much in accordance, as to leave little room for doubt on the subject.† Broken pieces of branches, varying from slender twigs to boughs half an inch in diameter, and about two inches long, were found mixed up with more finely divided vegetable matter, like comminuted leaves, in one case to the amount of from four to six bushels. We have the authority of Gœppert for the fact, that twigs of the existing Coniferous *Thuia occidentalis*, were identified in the stomach of the New Jersey Mastodon; and of Professor Asa Gray, and Dr. Carpenter, both eminent microscopical observers, that the stomach of the Newburgh Mastodon, contained fragments of the boughs of "some coniferous tree or shrub, and probably some kind of spruce or fir (Gray); and also, fragments of a quite different kind of wood (not coniferous), which from its decomposed and carbonaceous state was not determinable (Carpenter)." But these observations do not, in the slightest degree, advance our knowledge as to the probable food of the Mammoth; residuary bits of stick, half an inch in diameter, are reconcilable with the masticatory operation of the rude open valleys and *Trilophodon* ridges of the molars of the American Mastodon; but in the highest degree improbable as a result of the multiplex divisions of the flat molar crown of the Mammoth. We must be content to remain in the dark on this question, until the same kind of observation is applied to the contents of the stomach of the latter in Siberia,‡ as has been so successfully effected with the allied genus in North America.

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* Richardson. Polar Regions. 1861, pp. 275 and 296.

† Edinb. New Phil. Journ. 1829, Vol. 6. p. 285.

EXPLANATION OF THE PLATES.

Pl. I.—Section of the middle portion of an adult lower molar, of *Elephas Columbi*, from the post-pliocene deposit of the Brunswick Canal, near Darien, in Georgia, (p. 52): shewing the disposition and relative proportions of the ivory, enamel, and cement, as compared with corresponding sections of *E. Indicus*, and *E. primigenius*, contained in the Fauna Antiqua Sivalensis, Pl. 1. (Nat. size).

Pl. II. Fig. 1.—Represents the crown-aspect of an anti-penultimate true molar, of the lower jaw, left side, (m. 1.) of *E. Columbi*, No. 741^a Mus. Coll. of Surg. (antea, p. 50); the eight anterior ridges are worn, the rest being intact. From Mexico. (Nat. size.)

Pl. II. Fig. 2.—Represents the crown-aspect of the last true molar, (m. 3) upper jaw, left side, of *E Armeniacus*, from a specimen in the British Museum, No. 32,250, procured by Col. Giels, in the province of Erzeroum, in Armenia. (Antea, p. 74.) (Nat. size.)

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* Leonhard and Bronn's 'Jahrbuch,' 1846, p. 378; and Bronn's Lethæa Geognost. band. iii. p. 855.

† Warren. 'Mastodon Giganteus,' p. 166.

‡ In the researches upon the latest discovered Mammoths in Siberia, of which the details have been published, the remains of the brain, muscles, tendons, and periosteum have been microscopically examined, but not the contents of the stomach. *Vide* Gleboff, Bullet. Sociėt. Imper. de Moscou, 1846, xix. 2, p. 108, *et seq.*

VII.—On the so-called "Auditory-sac" of Cirripedes. By Charles Darwin, F.R.S.

In my work on Cirripedes I have described an orifice, previously unobserved, beneath the first pair of cirri, on each side of the body, including a very singular elastic sack, which I considered to be an acoustic organ. Furthermore I traced the oviduct from the peduncle to a mass of glands at the back of the mouth, and these glands I called ovarian. Dr. Krohn has recently stated that these glands are salivary, and that the oviduct runs down to the orifice, which I had thought to be the auditory meatus. It is not easy to imagine a greater mistake with respect to function than that made by me; but I expressly stated that I could never succeed in tracing the oviducts into actual union with these glands; nor the supposed nerve from the so-called acoustic sack to any ganglion. As Dr. Krohn is no doubt a much better dissector than I am, I fully admitted my error and still suppose that he is right. Nevertheless, several facts can hardly be reconciled with his view of the function of the several parts. To give one instance: if any one will look at the figure of the Anelasma (Lepadidæ, Pl. iv.), he will see how extremely difficult it is to understand by what means the ova coming out of the orifices (*e*) above referred to, could be arranged in the symmetrical lamellæ which extend up to the summit of the capitulum: it must be observed that the ova are united together by a delicate membrane enclosing each ovum; moreover the cirri in this animal are in atrophied condition, without regular articulations, so that it is inconceivable how the ova can be transported and arranged by their agency.

I have lately received from an eminent naturalist, Prof. F. de Filippi, a paper (Estratto dall' Arch. per la Zoolog. 31st Dec. 1861), chiefly devoted to the development of the ova of Cirripedes, in which the following passage occurs:—

"The small size of *Dichelaspis Darwinii* has not enabled me to verify the relationship discovered by Krohn between this problematical organ and the termination of the oviduct; but on the other hand the transparency of the tissues has enabled me to perceive a peculiarity of structure which may help to elucidate the question. Fig. 13 represents what I persist in calling a hearing organ. Within a cavity, the walls of which are united to the surrounding tissues, there is a pear-formed sack or ampulla. On the neck of this ampulla, at *a*, are numerous minute lines parallel to each other and to the axis of the ampulla. I doubted at first whether the appearance of these lines arose from folds in the membrane, and therefore I separated some of the sacks, and I could then better convince myself that these lines correspond with true nervous fibres, thin and simple, embedded in the rather thick, resisting, and transparent substance which forms the walls of the ampulla. This circumstance seems to me to show clearly the sensitive nature of the organ, and hence to favour Darwin's opinion, who considers them to be organs of hearing."

My object in asking you to publish this note, is to induce some one to attend to this curious organ; to endeavour to discover ova within the so-called auditory sack; for as each cirripede produces so many eggs, assuredly this might be effected without great difficulty. It is, however, possible (as I believe was suggested by Mr. R. Garner at the British Association, but whose paper I have mislaid,) that cirripedes, like certain Entomostraca, may lay two kinds of eggs; one set passing out through the problematical orifices; and another set coming out of the body in sheets, in the manner suggested by me;—namely, the ova collecting under the lining membrane of the sack before the act of exuviation, with a new membrane formed beneath them; so that the layer of eggs becomes external after the act of exuviation. If this view, to which I was led by many appearances, be correct, improbable as it may seem, it ought not to be difficult to find a specimen with the old membrane of the sack loose and ready to be moulted, with the new underlying membrane almost perfect, and with the layer of ova between them. Or a specimen might be found which had lately moulted, with its skin still soft, (and this I believe that I saw) with a layer of eggs still loosely attached to the new lining membrane of the sack.

VIII.—ON RIBS AND TRANSVERSE PROCESSES, WITH SPECIAL RELATION TO THE THEORY OF THE VERTEBRATE SKELETON. By John Cleland, M.D., Demonstrator of Anatomy, University of Glasgow.

(Read at the Meeting of the British Association at Cambridge, October, 1862.)

WHILE it often happens that, on comparing structure with structure in series of animals, anatomists become aware of close correspondences between objects that to all outward appearance are very different, in the comparison of ribs or transverse processes in the various regions of one animal, or in the series of vertebrata, what strikes the eye at first is their resemblance. They are naturally, in the first instance, assumed to correspond, and only when differences of detail one by one attract attention, is that first assumption put upon its trial and, by different judges, to a greater or less extent, set aside. The amount of palpable resemblance between vertebræ gives an air of simplicity to the question of the correspondence of their parts, when compared with questions which present themselves in connexion with the skull; and while some inquiries as to correspondences of cranial bones are liable to be cast aside as little better than dreams, the legitimacy of inquiring what parts of vertebræ correspond one to another stands beyond all question. It is important, therefore, for the interests of scientific anatomy, that it should be solved. If we cannot understand the laws of variation of the most constant elements of the skeleton, how shall we expect to comprehend those of the most changeable? Yet it is the fact that, though the bones and processes proceeding from the vertebral column have long been a subject of study to anatomists, and the varieties which they present have been carefully observed, and many of them minutely recorded, no one can point, amid the variety and uncertainty of opinion that still prevails, to any largely admitted demonstration of the relations of the transverse processes, ribs, and inferior spines of fishes to parts in the higher vertebrata.

Having had my attention recently drawn by circumstances very particularly to the processes of the vertebral column, and being confirmed in a conviction that the difficulties which have been encountered in the study of their correspondences have arisen in great part from the skeleton being looked on too often as a structure arranged round the chorda dorsalis as its sole axis, I venture, at the risk of being thought over-speculative, to tread upon this oft-trodden ground, endeavouring, however, to use not speculation, but analysis, as the instrument of inquiry.

Before passing to the more general part of the subject, we shall find that some useful lessons may be drawn from the simpler study of the varieties of mammalian vertebrae.

The processes passing out laterally from the vertebral column in mammals, viz. the transverse, the mammillary and the accessory, are well understood in their relations among themselves; and especially the varieties which they present in different families have been made the subject of elaborate investigation by Prof. Retzius.*

The learned Professor has very satisfactorily shown that the mammillary, accessory and transverse processes of the lumbar region in the human subject are all of them represented by the transverse processes of the dorsal region. That this is the case one may easily convince one's-self by observing on a well marked specimen the three tubercles upon the transverse process of the 12th dorsal vertebra. These tubercles are manifestly serial with the three processes in the lumbar region; while it is equally obvious that the whole process corresponds to the transverse processes of the vertebrae above it.

These correspondences are ably illustrated by Mr. Humphry in his "Treatise on the Human Skeleton" (p. 141). They become yet more fully appreciable on examination of the muscular attachments. We trace the transverso-spinales muscles passing upwards and inwards from the mammillary processes and from the superior and inner angles of the extremities of the dorsal transverse processes; while the inner row of attachments of the longissimus dorsi are inserted into the accessory processes, and into the inferior angles of the extremities of the dorsal transverse processes. The outermost tubercle on the 12th dorsal vertebra, although not furnished with a cartilaginous facet like the processes above it, is closely attached to the rib by ligamentous union; and where a 13th rib is present, this rib is similarly connected with the transverse process of the first lumbar vertebra. This connection is beautifully exhibited in a series of specimens collected by Professor Thomson, and used by him in illustrating his lectures. In one specimen, a short rib is anchylosed to the front of the left transverse process of the first lumbar vertebra, and has no other point of contact with the vertebral column; and in others there is a similar disposition without anchylosis. Thus the transverse processes of the lumbar vertebræ correspond to the parts of the dorsal transverse processes which support the ribs; and, being longer, to a certain extent they take up the functions of their prolongations the ribs themselves, for the external row of intertransverse muscles in the lumbar region are in series with the levatores costarum of the thorax, while the internal row of lumbar intertransverse muscles, passing from mammillary to mammillary process, are in series with the intertransverse muscles of the thorax.*

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* Ueber die richtige Deutung der Seitenfortsätze an den Rücken und Lendenwirbeln beim Menschen und bei den Saügethieren. Translated from the Swedish Müller's Archiv. 1849, p. 593.

I have thus dwelt on those manifest relations of the dorsal transverse process to the lumbar processes, because they lead to important general conclusions. They show that a process in one segment may be serial with more than one process in another segment, or, in other words, may become expanded in another segment into several processes. To put the matter more generally: structures which lie in series are not necessarily morphologically identical. Thus the mere suppression of the lumbar transverse and accessory processes would not render the mammillary processes complete representatives of the dorsal transverse processes; and hence we are prepared to meet with series in which the anterior members of the series have a different morphological value from the posterior members.

Let us now very shortly recount the principal facts with regard to the disposition of ribs and vertebral processes in different animals, and some of the theories which have been brought forward to explain them.

In mammals, birds, and reptiles the transverse process in the trunk arises in common with the neural arch, and is in serial connexion with processes in the tail which strike out transversely and are completely separated from the inferior arches frequently found in that region. Between the transverse and spinous processes other processes may appear; viz. the mammillary and accessory processes, which may become merged in the transverse processes.

Ribs tending to surround the visceral cavity are in the majority of cases articulated both to the tips of the transverse processes and to points close to the bodies of the vertebræ, variable in their exact position; but in certain cases they present only the former articulation, and in other cases they are described, not without error, as having only the latter.

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* This is noticed by Müller, Vergl. Anat. der Myxinoiden, p. 245.

On the other hand, in fishes those transverse processes which bear ribs tending to surround the visceral cavity are unconnected with the neural arch. They are in serial continuation with the inferior arches of the caudal vertebræ; and the ribs themselves are also in continuation with the distal portions of these arches or with the spines into which they are prolonged. But while this is the disposition of the transverse processes and ribs embracing the abdominal cavity, certain fishes present processes in the tail, which, lying in the lateral intermuscular septum, strike out transversely like the caudal transverse processes of mammals. Also in the same intermuscular septum there are in certain fishes articulated rib-like bones which strike towards the skin, and are attached directly to the vertebræ, or, in some cases in the forepart of the trunk, to the upper aspects of the ordinary ribs. They are sometimes described as the superior range of ribs. Besides all these, there are, in many fishes, rows of bones generally admitted to be of only secondary importance, disposed one row above and another row below the middle lateral line. They are very fully developed in the herring, in the trunk of which the superior row are given off from the bases of the neural arches, and the inferior row are attached by ligament to the bodies of the vertebræ, while both rows are continuous at the commencement of the tail with bones more loosely connected with the vertebræ, and forked at their proximal extremities, and these are continuous at the back of the tail with others in which the forked condition has disappeared, and which lie almost entirely on the surface of the muscular mass.

Johannes Müller,* to explain the differences of arrangement of ribs and transverse processes in fishes and other vertebrata, distinguished no less than four kinds of transverse processes: viz. the ordinary mammalian, attached to the neural arch; the ordinary piscine, forming the hæmal arch, to which he also referred the inferior arches in tails of mammals and reptiles; a row superior to the ordinary mammalian, viz. the mammillaries; and a row superior to the ordinary piscine, to which belong only the superior transverse processes of fishes, and the lumbar and caudal transverse processes of the cetacea, which differ from those of other mammals in being attached to the centra without connexion with the neural arches.† He maintained that it was characteristic of a rib to embrace the visceral cavity, and therefore considered that the piscine and mammalian ribs were corresponding structures, and that the articulation of the head of the mammalian rib to the body of the vertebra was that which corresponded to the attachment of the piscine rib.

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* Vergleichende Anatomie der Myxinoiden, p. 100.

† Müller indeed states (Op. cit. p. 100), "the transverse process of the lumbar and caudal vertebra in the cetacea is developed merely from the centrum of the vertebra, as I have satisfied myself in the young Narwhal:" but in a fœtal cetacean of uncertain species I find that it is ossified from a centre of its own.

To accept this theory involves the assumption that the exact point of origin of a process or rib from the vertebra, and the source of its ossification are matters of primary morphological importance. But even with mammalian ribs there is a considerable amount of variety in the method of attachment to the vertebræ. Thus the posterior ribs in the cetaceans are attached only to the transverse processes; and these processes, according to Müller, are neither the ordinary piscine nor mammalian transverse processes. Ordinarily, the head of the mammalian rib is attached to the origin of the arch, a circumstance which is in itself adverse to Müller's theory; but the posterior ribs in the Seal, and probably also in some other carnivora, articulate with centra; and in the Echidna, whose ribs have no costo-transverse articulation, Prof. Huxley remarks that "the head of every rib is attached to the centrum, or below the neuro-central suture, and in the neck this suture lies between the upper and lower transverse processes;"—a remark which I have verified, with the slight exception that in the specimen which I examined, the last pair of ribs was attached quite above the neuro-central suture. Hence it appears that the points of attachment of ribs to vertebræ are not of any great morphological importance. Neither shall we find that the source of ossification of processes, although it has a certain importance, is of primary significance. There are caudal vertebræ in many mammals, the Dog for example, entirely ossified from the centra; which send upwards very small pairs of processes forming the rudiments of neural arches, and outwards small transverse processes. Whatever we may think of the latter, we cannot fail to see that there is a greater amount of correspondence between the former and neural arches than can be counterbalanced by the fact of their being productions of the centrum and not autogenous. In fishes and reptiles there are other varieties in the source of ossification of the neural arch which need not be here enumerated.* So also the anterior part of the upper jaw in man indubitably corresponds to the intermaxillary bone in any other mammal, although, except in cases of cleft palate, it is ossified, as M. Em. Rousseau has shown, from the maxillary. In the face of these evidences of variability in the sources of processes it is impossible to admit that the mere circumstance that the transverse processes in the posterior part of the Dolphin's vertebral column arise from separate centres of ossification, and are attached to the sides of the bodies of the vertebræ, affords sufficient ground for distinguishing them as a different order of processes from those in front, with which they form a continuous series.

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* On this subject and on the attachment of ribs, see Prof. Huxley's note, "On the development of the Ossified Vertebral Column," appended to his lecture "On the Theory of the Vertebrate Skull." Royal Soc. Proc. Nov. 18, 1858.

August Müller, in a highly[*] elaborate paper, concludes that the ribs embracing the abdominal cavity in fishes are peculiar to that class of animals, and that the ribs of the other vertebrata correspond to the bones, in fishes, which lie in the lateral intermuscular septum, differing from them only in being prolonged beneath the skin to the middle line below, so as to embrace those muscles which are equivalent to the mass lying below the lateral intermuscular septum in the fish. He therefore recognises two sets of transverse processes and two sets of ribs, but the division into rib and transverse process he considers, and indeed proves, to be of very secondary importance. The rays which in certain fishes are found in the flesh, above and below the middle lateral line, he allows to be secondary. To this theory we must return.

Professor Owen[†] recognises two sets of transverse processes, the parapophyses and the diapophyses: but he only admits one set of ribs or pleurapophyses ; and these may be connected with either the parapophyses or diapophyses, and may either strike outwards or be interpolated between their supporting processes and the hæmapophyses. Thus the only constant characteristic which seems to belong to them, is that they are ossifications distinct from the vertebral processes which support them. They form a very distinct part of the conception of a typical vertebra, as laid down by the learned Professor ; and one understands at once the part which in their character of an ideal element they are supposed to play ; but the difficulty is, in the application of the conception, to say what characters shall constitute the claim of a particular process, or part of a process, to be considered pleurapophysial. This is more especially the case, as Professor Owen recognises that the source of ossification of a structure is indeed of no primary significance, speaking as he does of "connation" and "coalescence" of elements. Thus, speaking of a vertebra from the tail of a Serpent, he says: "All the parts are coalesced into one bone: the pleurapophyses appear as short deflected extremities of long diapophyses."[‡] Again, describing the skeleton of a Dugong, he says: "There are 19 dorsal vertebræ, but the 19th pair of ribs are much shorter, straighter, and more slender, than in the rest, and illustrate the nature of the transverse processes of the succeeding vertebræ, which are short and straight anchylosed ribs."* Now if there be no evidence from young specimens that the tips of the transverse processes in the Serpent's tail and the lumbar vertebræ of the Dugong contain separate centres of ossification, what is the objective reality expressed by calling them pleurapophyses? Besides all this, if, in its typical condition, the pleurapophysis be a bone striking directly outwards from a vertebra, what objective link is there between it and a rib in the ordinary acceptation of the term?

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[*] Beobachtungen zur vergleichenden Anatomie der Wirbelsaüle. Müller's Archiv. 1853, pp. 260-315. My attention was first drawn to this paper by Professor Goodsir, in his summer courses of lectures on Comparative Anatomy. The same theory presented itself independently to his mind before he had seen August Müller's paper. But whatever his sentiments may have been with regard to it, he has not extended to it the support of his published opinion, and I only mention these circumstances, because having thus seen that many arguments could be brought forward in favour of August Müller's theory, I have been led the more fully to take it into consideration now.

[†] On the Archetype and Homologies of the Vertebrate Skeleton. The disposition of the pleurapophyses is given at p. 99.

[‡] Descriptive Catalogue of Osteological Series in the Museum of the College of Surgeons, Vol. i. p. 6, No. 26.

The doctrine of Professor Owen, that there are two sets of transverse processes, diapophyses and parapophyses, has been very generally accepted in this country, even by those who are far from agreeing with the main features of his theory of the costal arch. It has been taken into consideration that in the higher vertebrata the rib is usually connected with the vertebra at two places, that in certain instances, in birds and reptiles, the head of the rib is supported by a process as well as the tubercle, and that this process resembles the transverse process of the fish more nearly than does that which supports the tubercle, in that it is unconnected with the neural arch; hence it and the transverse process of the fish have been called parapophyses, and the transverse processes of the higher vertebrata diapophyses. The transverse processes of fishes are thus presumed to correspond completely with the processes for the heads of ribs in other vertebrata, and to differ totally from the transverse processes in these. Also, in like manner, a complete correspondence must be maintained to exist between transverse processes of the higher vertebrata, and the superior row sometimes found in fishes. I hope, however, to prove, ere I conclude, that these are not the relations of these various processes. At present it may be noted that while the transverse processes of the tail in the Conger, Plaice, and other fishes have a very distinct correspondence to those in tails of mammals and reptiles, they are as truly in series with the ordinary piscine transverse processes in the trunk as are the inferior arches.† The undivided transverse processes of the trunk in the Conger are likewise in series with two rows of transverse processes on the vertebrae immediately behind the head, and the upper of these two rows has no apparent correspondence with the upper row which appears posteriorly.

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* Ibid. Vol. ii. p. 459, No. 2543.

† I ought to notice that Professor Owen does not state that these processes are diapophyses. In describing the skeleton of Muræna Helena he states that "the caudal transverse processes are due to a progressive bifurcation of the parapophyses;" and of the Plaice he says that "the hæmal arches are formed by special processes or divisions of the parapophyses, the external portions of which continue to project outwards, as independent transverse processes." Descriptive Catalogue of Osteol. Series, Mus. Coll. Surg. Vol. i. pp. 14 and 48, Nos. 37 and 179.

Before making any attempt to clear a subject, on which so many theories have been formed, we shall do well distinctly to appreciate, that such discussions as that which engages our attention, as indeed all morphological questions, resolve themselves into investigations of the relative amount of significance to be attached to different classes of phenomena. We compare structures, and inquire in what respects they differ and in what they correspond. The question then arises; what points of difference or correspondence are we to consider of primary importance, and what points are subordinate? The importance of such points can only be estimated by their prevalence in a series of animals, and the time of their appearance in the embryo. Thus, for example, we have already seen that the method of ossification and the exact place of origin of a part of a vertebra are not matters of primary importance, because structures closely related and comparable, are found very variable in this respect. The point which I proceed to prove is that the distinction of greatest importance, in classifying the elements of a sclerotome, is that which divides parts into those which embrace the visceral cavity and those which do not.

I start from this point, because all the theories mentioned above take for granted that the vertebral column is an axis to which typically the neural arch is related on one aspect, as the visceral arch is related on the opposite aspect: a proposition totally at variance with that now put forward. In fact, none of those theories can be held without considering the chorda dorsalis and bodies of the vertebrae as the pivot round which the symmetry of the whole animal is arranged. Now the only part in which the bodies of the vertebrae ever occupy such a position is the tail; and in it, especially in fishes, there is, no doubt, often an almost perfect supero-inferior symmetry pervading not the skeleton merely but likewise other systems. August Müller goes the length of saying "Cauda ansa est morphologica." But a segment of the tail cannot be taken as a typical segment of the body. We must take a part where all the layers of the embryo are represented. The symmetrical arrangement of parts round the vertebral centra in the tail only shows that when the skeleton and muscular system are prolonged backwards beyond the viscera, the parts so prolonged tend to arrange themselves symmetrically round the bodies of the vertebrae. In the tail, not only is the intestinal canal absent, but the caudal vessels are no fair representative of the vascular system, which, in its typical disposition, completes circles round the digestive tube. Thus the aorta is not the whole morphological axis of the arterial system; the vessel which forms the heart is a prior development, and branchial arches are found at an early period in all vertebrata. Indeed the vascular system affords a key to the true fundamental arrangement of the different systems in relation to one another; viz. that they circle round the alimentary tube. This arrangement was recognised by Carus years ago, but mixed up, as his statements on this subject have been, with a method which led him to many merely fanciful results, they have received less attention than they might otherwise have met. The alimentary system is encircled by the vascular system in all the types of animal form in which blood-vessels are found. Then, in the nervous system, almost the only point of resemblance between the vertebrata and articulata is that the great nerves tend, in both, to embrace the visceral cavity; and passing further down the scale of life, we find, in the Echinodermata and other forms, that the nervous system completes a ring around the alimentary system; while, descending even to the lowest forms, we still meet with a sensory and motory exterior surrounding a digestive interior.

But, waiving at present that description of evidence, and returning to our line of argument, we proceed to prove by the aid of embryology our proposition, that, in the trunk, the elements of the skeleton are primarily divisible into those which embrace the visceral cavity and those which do not.

Let us recall to mind that the embryo makes its first appearance in the plane of the germinal membrane; that the layers into which it divides are continuous with, and continued into the germinal membrane; and that they fold inwards in such a manner that the products of the internal layer are completely surrounded by those of the middle layer, and those of the middle by those of the outermost layer.* The cerebro-spinal axis, being developed from the most superficial layer, must be considered as fundamentally a superficial formation. Doubtless it soon closes upon itself to complete a cylinder, and processes grow up on each side of it, which join to form the neural arch; but the cylinder which the cerebro-spinal axis forms cannot be compared with that formed by the epithelial lining of the intestine; for the latter is the whole internal layer of the embryo, while the former is the product of only a small portion of the external layer, the rest of which, forming the epidermis, extends in a complete circle round the body, and is the outermost ring, just as the intestinal epithelium is the innermost ring. Much less can the whole contents of the costal arch, including the products of the musculo-intestinal layer and the whole axial part of the vascular system be compared with the contents of the neural arch. Neither can the structures which enclose the cerebro-spinal axis be compared with those which enclose the visceral cavity, for the latter are continuous with the germinal membrane, while the former are elevations or processes derived from the latter. Confining our view, lastly, to the skeleton; the elements which form the costal arch lie in the direction of the dorsal plates, from which they are formed, and which are portions of the middle layer of the embryo; and the observations of Remak have shown us that from each dorsal plate there is a nervous, an osseous and a muscular element developed, which all, stretching out in the plane of the primary layers, tend to complete their circles. But the laminae of the vertebrae are at right angles to the main direction of the dorsal plates and the layers of the embryo; and even as the elevations of blastema in which they are developed are processes from the middle layer of the embryo, so do the laminae diverge from the main circle of the skeleton, and in that respect they are to be compared with the various processes directed outwards to the skin in fishes, and with the epicostal bones in birds.

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* Indeed the embryo may with perfect propriety be considered as a bud derived from the germinal membrane, after the method of alternate generation. This idea has been already put forth by Dr. Ogilvie of Aberdeen, in his work on 'The Genetic Cycle in Organic Nature,' p. 157.

Owing, however, to the embryo being only a bud from the germinal membrane, not enclosing the complete sphere of the ovum, the rings in which its parts lie do not pre-exist, but are gradually formed by growth from one side and subsequent closure. From the very first, therefore, symmetry between the dorsal and ventral aspects is impossible. Development proceeds from the dorsal to the ventral aspect, because the dorsum is, in the first instance, the centre; while that which is to become the ventral mesial line is the circumference of the embryo. Hence the importance in position of the chorda dorsalis. We can freely admit that the chorda dorsalis is the centre of development of the skeleton, and yet recognise that the skeleton and other systems primarily circle round the alimentary tube.

From the foregoing argument, it follows that ribs embracing the visceral cavity correspond, and that transverse processes supporting ribs correspond. They are members of the primary circle, and the exact place and manner in which they are articulated or ossified to the vertebral column depends on details of later development. There is thus no difficulty in recognising the correspondence between the ordinary transverse processes of fishes and those of mammals.

But it will be said that the point of articulation of the head of the rib is, in that case, the part in the mammal, bird, or reptile which corresponds with the transverse process in fishes. On that subject it may be noted that while we have abundance of instances of mammalian, ornithic and reptilian ribs supported by transverse processes only, we have no instance of the rib failing to articulate with the transverse process when the latter is present. It was previously pointed out that the floating ribs in man, generally supposed to be an exception to this, do really articulate with the transverse processes, though not by means of synovial surfaces, and that, in cases of thirteen ribs, the additional rib is attached to the transverse process of the first lumbar vertebra. This accords so far with Rathke's statement, that "where the transverse process occurs, the rib is, in all cases, at first united only with it; sometimes, however, a process grows out from the rib (the so-called head with its neck), by which it becomes immediately attached to the body of the vertebra itself, so that it is doubly united with the body." The propriety, however, of considering the head and neck of a rib as a process is highly questionable. Professor Huxley,* from whom I have quoted this translation of a passage in Rathke's *Entwick. der Natter*, has been led by observations on the embryo Mouse to the precisely opposite conclusion, that the mammalian ribs are not primarily connected with the transverse processes, but are primarily contiguous with the centra of the vertebræ. The opinion at which I have myself arrived is quite in accordance with Prof. Huxley's observations, yet differs from both his conclusion and Rathke's.

I maintain that the costo-vertebral and costo-transverse articulations are mere subdivisions of an articulation which in certain cases is found single. I am convinced, from observation of young human and other skeletons, and, indeed, from Prof. Huxley's woodcuts of vertebræ of the embryo Mouse, that the early connexion of the rib to the vertebra includes both the articulation of the head and of the tubercle, that the transverse process is developed from the part of the vertebra already in contact with the rib, and that the neck of the rib is formed *pari passu* with the transverse process.

This view is very well illustrated in the back part of the thorax of the Horse. In the articulation of the last rib of the Horse there is manifestly an anterior inferior portion, corresponding to the articulations of heads of ribs further forward, and a posterior superior portion distinctly costo-transverse in nature. Perhaps we shall also be justified in considering, in the case of Serpents in which the vertebra presents for articulation with the rib a concavo-convex surface, that the anterior inferior concave part articulates with the round head of the rib, and that the remainder of the joint corresponds to the costo-transverse articulation, in which, according to the general rule, the convexity is on the vertebra.

Returning now to the question, whether the transverse process or the articular surface for the head of the rib in the mammal corresponds to the ordinary transverse process in the fish: it is important to notice that *the correspondence of structures is a thing of degree;* that the transverse process of the mammal corresponds to that in the fish, in respect that it is an element of the primary circle or costal arch; and that the articular facet for the head of the rib, especially if elevated on a process, has also that amount of correspondence to the fish's transverse process, with the additional less important resemblance of arising sometimes from the centrum; while both processes together, the mammalian 'diapophysis' and 'parapophysis,' correspond to the ordinary transverse process or 'parapophysis' in the fish, in respect that they together form the base from which the rib starts outwards on its course round the visceral cavity. Only in this manner can all the facts be reconciled.

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* Loc. cit. pp. 69 to 74.

Seen from this point of view, the question whether the inferior limb of origin of the mammalian cervical transverse process is to be accounted transverse process or rib, is little more than a dispute of words. The fact stands simply thus: that the structure in question belongs to the primary circle, and that, as was particularly observed by Meckel, it sometimes contains a special centre of ossification. In the sacrum there are centres of ossification so independent and constant that they may be with much less hesitation compared to ribs.

We are now enabled also clearly to see that, although, as has been shown, the mammillary, accessory and transverse process of the lumbar region are all represented, in the human subject, in the extremity of the transverse process of the dorsal region, the main part of the latter is purely transverse in its nature, inasmuch as the characteristic property of a transverse process of the trunk is to take part in the formation of the primary circle.

It may still be objected by the upholders of August Müller's theory, that, after all, the mammalian ribs and transverse processes correspond to the upper row of ribs and transverse processes in fishes; that what constitutes the lining wall of the fish's abdomen is to be sought in higher animals in the fascia on the ventral aspect of the muscles inside the ribs; which muscles, he considers, represent the mass inferior to the lateral intermuscular septum in fishes.

This view of the correspondences of muscles, however, will not stand close scrutiny. In the Saurian tail the lateral intermuscular septum is found as in fishes. The muscles superior to it are, as August Müller rightly observes, continued into the muscles of the back; but the muscles below that line cannot be justly described as continued into the interior of the visceral cavity; the superficial ones are attached to the pelvis, and continuous with them in front of the pelvis are those muscles of the abdomen which lie superficial to the ribs; among others the rectus, which can already be easily distinguished in some fishes. When the forepart of the tail is laid open, we find, indeed, two masses of muscle continued into the abdominal cavity, and which, as was shown by Professor Goodsir,* are enclosed in the continuation backwards of the lining membrane of the abdomen; but that that membrane corresponds not to the lateral intermuscular septum of the fish, but to the lining membrane of the fish's abdomen, is proved by the co-existence of the lateral intermuscular septum, which finds its way to the skin as in fishes.† Forward in the trunk there are both infra-costal and transversi-abdominis muscles internal to the costal arches; but the main trunks of nerve are outside these, not on their abdominal aspects, as they would have been were August Müller's theory correct. Hence it appears that the costal arches of the higher vertebrata are the same as those of fishes, and that the layer of muscle found in their interior is a development peculiar to them, which, like various other muscular developments, is in fishes not yet separated from the common mass.

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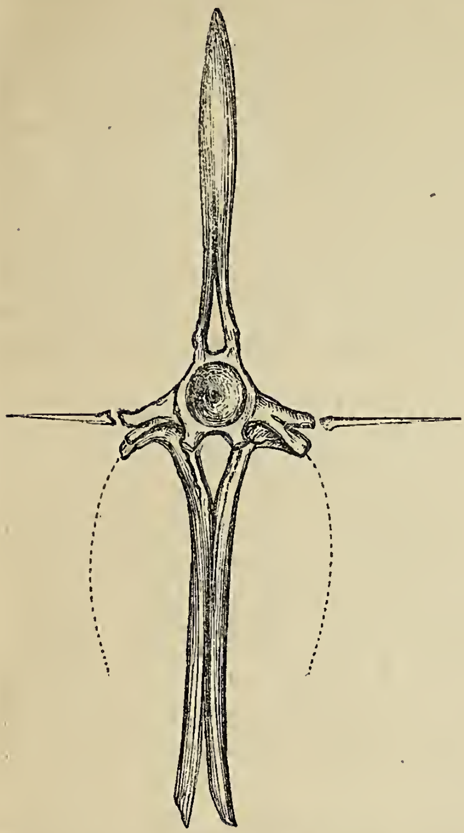
* Edin. New Philos. Journal, Jan. 1857, p. 128.

† In some reptiles, the prolongation backwards of the abdominal membrane so well seen in the crocodile is not brought to a point, but is lost among the muscles of the tail with whose segmented mass the included muscles are also blended. Thus also, the abdominal cavity in birds and mammals is always incompletely bounded behind.

In proceeding to consider the processes continuous in the tail with the ribs and transverse processes of the trunk; it is essential to bear in mind that where there is no visceral cavity there can be no parts entirely corresponding to ribs and transverse processes, if the primary characteristic of these parts is their relation to that cavity. The importance now becomes apparent of the principles formerly laid down, that a single process may be serial with more than one row of processes, and that processes in series do not necessarily completely correspond. It is thus that, in the Flounder and the Conger, the simple transverse processes in the middle of the trunk are continuous with a superior and inferior set behind. Were the superior set cut off, we should have the disposition met with in most fishes. Were the inferior set cut off, we should have left the continuity of the transverse processes of the trunk with those of the tail, as found in the other vertebrata. In that case there would remain simple processes, the upper parts of which would be in the abdominal wall, while their extremities would diverge into the intermuscular septum, and so would become radiative. Probably there is not, in the higher vertebrata, any transverse process to be found which distinctly presents these relations. The transverse processes in the commencement of the Crocodile's tail would exhibit them, if their course were continued outwards as far as the skin; but, as it is, they stop short where the lateral intermuscular septum separates from the abdominal wall. The transverse processes in the back part of the trunk of the Haddock, however, afford a good example of processes beginning in the abdominal wall and ending in an intermuscular septum radiating outwards. In this instance the ribs continue the circle round the abdomen, and in the first caudal arch there is a complete circle with processes which project from its sides in series with the tips of the transverse processes.

The same relation to the abdominal wall is exhibited in fishes which have only the superior set of ribs. In *Aspidophorus europæus*, for example, these bones in the first part of their course bound the abdominal cavity, but from the point where the lateral septum is given off they quit the abdominal wall and the intercostal nerves, and shoot out along the septum to the skin. I have not had an opportunity of dissecting *Draco*, but I apprehend that very similar remarks are applicable to its free ribs.

In *Naseus fronticornis*, the first caudal vertebra of which is here figured, a very illustrative example is afforded of the transitions of series of processes at the commencement of the tail. In this fish, the first inferior caudal spine and first anal interspinous bone are arranged very much as in the pleuronectidae; but, whereas in the pleuronectidae the projections of the abdominal cavity behind this point are irregularly formed pouches running along the sides of the interspinous bones, in *Naseus* the membrane lining the abdominal cavity is disposed in the fore part of the tail as it is in the trunk, though the space embraced by it is divided vertically by the inferior spines; which is exactly the arrangement shown by Prof. Goodsir to take place in the tail of the Crocodile, save that in this instance the divided part of the cavity contains not muscle, as in the case of the Crocodile, but viscera. This condition is neither typical of the trunk nor of the tail, but is a transition form. *Naseus* possesses both a superior and a true set of ribs; the former is continued into the tail, but the latter ceases on the penultimate trunk vertebra. The bodies of the trunk vertebrae also are grooved for the great vessels. The inferior arch of the first caudal vertebra, with its spine, is continuous with the borders of the groove on the vertebra in front, so that the canal which the trunk vertebrae forms incompletely becomes perfect on the first caudal vertebra, similarly to the arrangement in *Lophius piscatorius.* In addition to this, the limbs of the inferior arch are so stout, and arise so much from the sides of the body, that they present a certain appearance of series with the transverse processes in front, as in the generality of fishes. But, besides its inferior arch, the first caudal vertebra presents on each side a bifid transverse process quite serial with the transverse processes in front, its inferior border lying in the prolongation backwards of the visceral wall, and the superior point of its bifid extremity giving attachment to a rib of the superior series, *i. e.*, to a bone lying in the lateral intermuscular septum. This bifid process, therefore, is quite similar to the bifid processes at the back part of the trunk of the Conger; yet in series with the upper and lower parts of the processes in the Conger we find respectively simple transverse processes in the lateral intermuscular septa and inferior spines, while in *Naseus* we find bifid transverse process and inferior spine co-existing in the same vertebra.



According to the principles laid down, the morphological relations of the various processes in the first caudal vertebra of *Naseus* may be stated thus: that the undivided part and inferior extremity of the transverse process together correspond in greatest degree with the transverse processes further forward, inasmuch as these portions lie in the primary circle; while the small superior part of the bifid extremity of the transverse process, as well as the bone which it supports, is a radiation outwards from that circle; and the limbs of the inferior arch are radiations or "actinal elements" (if that term be preferred) directed inwards. The neural arch being likewise formed by two radiations, the neural and inferior arches are in that respect corresponding structures placed above and below the centrum.

Behind the limits of the abdominal cavity there can be no longer any talk of primary rings and radiations. Relation to the visceral cavity has ceased, and the processes are correctly grouped according to their relations to the bodies of the vertebrae. A tendency is also observed to supero-inferior symmetry round the bodies of the vertebrae, but it is a peculiarity of the tail, and in harmony with the very different development of the tail contrasted with that of the trunk. For the tail is not developed like the trunk from a series of layers which fold inwards and form invaginated cylinders, but it is a solid projection backwards from certain of the layers, growing out as a mesial limb or appendage to the trunk.

Where the caudal relations are fully established, the inferior arches in all animals very evidently correspond, but they are serial with very different structures further forwards in different species. Thus, in *Naseus* they are continuous, at the fore part of the tail, with vessel-embracing arches internal to the visceral cavity; and only through these or through the divided portions of the abdominal membrane do they become serial with transverse processes. In *Lophius piscatorius* they are only continuous with imperfect vessel-embracing arches. But in the *Gadidae* they are directly serial with the structures bounding the visceral cavity; and in some species, *e. g. Gadus barbatus*, we find complete rings of great size, terminating in spines, encircling the abdominal cavity a considerable way forwards. They never, however, enter into typical segments of the body, for they never pass in front of the vent, which, though not a primary opening, is still morphologically the hinder extremity of the digestive system.

In Saurians the inferior caudal arches are only in series with structures projecting into the interior of the visceral cavity: those in the anterior part of the tail so project; and further forwards, in series with them, there are, in certain species, imperforate processes projecting in the middle line, and not even forking to enclose the great vessels.

Still another arrangement is met with in *Menobranchus lateralis*. In series with the transverse processes of the trunk, there are, in the anterior caudal vertebrae, sometimes as many as three pairs of lateral processes, and an inferior arch and spine. If we were to compare, in the dry skeleton, one of these vertebrae with the first caudal vertebra of *Naseus*, we should say that the inferior pair of lateral processes in the former corresponded with the inferior portions of the lateral processes in the latter. But were we so to judge we should make an egregious mistake as to the whole anatomy of the part. For when the soft parts are before us, we see that in *Menobranchus* as in *Naseus* the visceral cavity is prolonged further back than the first caudal vertebra, but that it lies entirely below the inferior caudal spine, whose tip only reaches its upper margin. When we reflect that the great vessels embraced by the inferior arch are properly internal to the visceral cavity, we see that the explanation of the phenomenon is, that the abdominal laminae, after starting from the vertebral column, have come into contact beyond the great vessels, and have again separated to complete their proper circle, without, however, the osseous elements being prolonged into this latter part.

In the same way is to be explained the difference of structure in the skeletons of the Flounder and Sole; for while, in the Flounder, the inferior arch of the first caudal vertebra is in series with a pair of transverse processes on the last trunk vertebra, disposed as in the generality of fishes; in the Sole, it is in series with inferior arches on the six last trunk vertebrae terminating in spines similar to itself. But these spines do not project at all into the abdominal cavity; they are structures lying, as truly as the transverse processes of the Flounder, in the abdominal laminae; only, on account of the flattened form of the fish, and the great development of the muscles compared with the viscera, the laminae are temporarily united, so as to separate the primary circle into a superior division for the great vessels and an inferior division for the viscera. A similar disposition of the abdominal laminae is found in the Mackerel; but in the Mackerel they separate again immediately after coming in contact, and to the tips of the arches completed in the line of their subaortic union are attached ribs which pass round the visceral portion of the primary circle. In the Herring the line of subaortic contact is stretched out transversely, and in it are found bridges uniting the transverse processes of opposite sides, whose extremities are prolonged some distance onwards in the visceral part of the circle.

Besides this arrangement, there also occur adventitious fibrous septa stretching across a part of the abdominal cavity, binding down the kidneys, or swimming bladder. These are of very secondary importance in the plan of the animal structure.

Conclusion.—Many points with regard to processes and bones connected with the vertebrae and ribs, and imbedded among the muscles, have not been even alluded to in these remarks, but their leading aim has been to convince anatomists that the key to the comprehension of the skeleton of the trunk is to be found in its double relation to the visceral cavity and chorda dorsalis; both being to it centres, yet in very different senses, the former being that which it tends to encircle, and the latter the line from which its efforts to encircle the former begin. Thus, where there is least development of the visceral cavity, there is most tendency to radiation round the vertebral column. Hence the attachment of the lateral intermuscular septum of fishes, and the bones contained in it, to the ribs in front, nearer the vertebral column further back, and to the sides of the bodies of the vertebrae behind; and hence, also, the so frequent connexion-by-series of transverse processes in the fore part of the trunk with several sets of processes behind.

When the visceral cavity has entirely disappeared, caudal relations become fully established, and then the inferior arches correspond more closely to the neural arches of their own vertebræ than to the visceral arches of the trunk vertebræ.

The correspondence which inferior arches exhibit to one another in the various classes of vertebrata is greater than the differences which they present in respect of attachment, or of the structures with which they are in series.

Transverse processes or ribs tending to surround the visceral cavity may be attached to various parts of the vertebræ, but nevertheless have a primary correspondence to one another.

Structures which surround the visceral cavity, such as ribs and the processes supporting their heads and tubercles, are more closely allied to one another than to structures projecting into the muscles, such as the superior transverse processes and ribs of fishes.

IX.—NOTE ON AN ABNORMALITY IN THE OSSIFICATION OF THE PARIETAL BONES IN THE HUMAN FOETUS. By Ramsay H. Traquair, M.D.

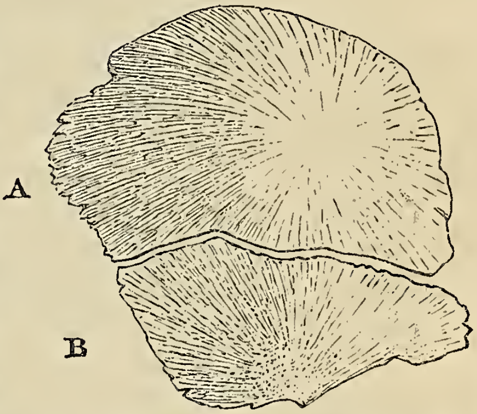
SOME time ago I dissected the head of a human foetus of between eight and nine months, in which the parietal bones presented a condition apparently at variance with the well known rule that these bones are two in number, and each developed from a single ossific centre.

In this cranium the parietal bone of the left side is perfectly normal, being ossified from one centre which corresponds with the well marked parietal eminence.

On the right side, however, the part which represents the parietal bone is divided into two distinct pieces, in a line extending from the middle of its posterior margin obliquely forwards to a little above its anterior-inferior angle. Of these two pieces, each of which is of course ossified from its own centre, the lower is accordingly somewhat triangular, and is equal in size to one-half the upper rudely quadrangular part: and the two pieces form together a double parietal bone, which is larger by about one-fourth than the single bone of the opposite side.

This cranium is therefore abnormal.

1. In possessing three parietal bones instead of two.
2. In the asymmetrical disposition of these bones—two being on one side, one on the other.
3. The vault of the cranium is also asymmetrical, in this respect, that the double parietal bone of the right side is considerably larger than the single one of the left.



The only other analogous case, of which I am at present aware, is one recorded by Von Sömmering.* He has described and figured, not a foetal, but an adult skull, apparently of a man between the ages of thirty and fifty, in which the parietal bones of both sides are divided by longitudinal sutures, each into two equal parts—making in all, four symmetrically disposed parietal bones. This skull then differs from my foetal one, in which there are only three such bones unsymmetrically disposed, and in which the two parts of the divided parietal bone are not equal, the upper piece being twice the size of the lower.†

I may also state that the foetal head, the peculiarity of whose parietal bones I have just described, presented in a marked manner the condition of Split Palate. In the recent state the interior of the nasal fossae was completely visible on opening the mouth: and as regards the dried bones, the palate plates of the superior maxillary and palate bones are entirely deficient, the superior maxillary bone articulating with its fellow of the opposite side only in front, and by the part corresponding to the intermaxillary of the other mammalia. Further than this the cranium presents nothing worthy of note.

Explanation of the figure. Diameter one-half nat. size.
A and B upper and lower pieces of the double bone of the right side.

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* Tiedemann und Treviranus, Zeitschrift für Physiologie II. (1826).

† Since the above notice has been in print, I have seen in Henle's Anatomy, a reference to another similar case recorded by Gruber,—Abhandlungen aus der Menschl. und Vergl. Anatomie, s. 113. Unfortunately I have not yet had an opportunity of seeing this latter work.

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THE

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Reviews.

XIV.—On Species. By A. De Candolle.*

There are two classes of Naturalists, viewing the great question of the Origin of Species from as many points of view, whose opinions, in so far as they are founded on faithful observation, are entitled to grave consideration, and perhaps to equal weight. Of these the first includes Physiologists and Anatomists, who investigate the minute structures, order and methods of development, of the organs of animals and plants, and the absolute and relative values of the functions performed by these organs. The second includes systematists, who apply the results of the Physiologists' and Anatomists' studies, together with those of their own special labours, to the discovery of the kinds and degrees of relationship existing between the groups of animals and plants. Amongst the latter, Professor De Candolle holds a distinguished place under every point of view, and may therefore claim, with confidence, an attentive hearing from Naturalists during the present crisis. And that the result will not disappoint us, it is the purport of this article to show in the following resumé of, and remarks upon, his learned and most conscientious paper.

The necessity of making a complete systematic revision of the whole family of Oaks, Chesnuts, &c. for the XVIth volume of the "Prodromus Systematis Vegetabilium," has offered to Professor De Candolle an opportunity of testing the theory of the Origin of Species by variation and natural selection, by studying the characters of a very large group of very variable but conspicuous plants, found both recent and fossil, throughout nearly the whole Northern hemisphere. Amongst all the collections brought together for this revision, M. De Candolle discovers little novelty, and he therefore turns with eagerness to subsidiary questions* which their study offers for solution, and says,—"Given a large assemblage of analogous forms, I have endeavoured of these to constitute subordinate and allied groups, proving, as far as possible, the value of each. Having thus fixed a small number of truly natural groups, I shall be better able to comprehend their true nature and to divine their origin, which is my object."

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* Étude sur l'Espèce, à l'occasion d'une revision de la famille des Cupulifères, par M. Alph. De Candolle. Tiré de la Bibliothéque universelle de Genève. (Arch. des Sciences Phys. et Nat.) Nov. 1862.

1.—*Grouping of Cupuliferous Plants.*

After enumerating the collections and their extent, upon which he has worked, M. De Candolle makes the following observation:—In oaks and their allies certain characters vary upon the same branch, and cannot, therefore, afford specific characters; and when the variations on the same branch are very marked, as the leaves being entire and toothed, or the base of the limb blunt and sharp, he takes note of the number of branches, amongst all the specimens, on which both characters existed. Thus, of 84 specimens of *Q. coccifera*, L., 13 had leaves—some entire and some toothed; whilst, in all the rest, all the leaves were either entire or toothed. Unfortunately other characters were not so easily classed, because they varied more in degree—such is the case with the length of the leaf-stalks, the lobing, &c. of the leaves, and the swelling of the scales of the cup.

The principal variations, observed by the author, in the organs *on the same branch*† of Cupuliferæ occur in the length of the petiole, which varies between 1 and 3;—the form of the limb, from an elongated ellipse to ovoid and obovoid;—the lobing or toothing of the leaf, which presents innumerable variations from entire to pinnatifid;—extremity of the leaf, from acute to blunt;—base of the leaf, sharp, blunt, or cordate;—pubescence of leaves; for although almost all have the young leaf pubescent beneath, in older states there may be persistent and caducous hairs on the same leaf;—bracts and male perianth, the bracts being very caducous afford no good characters in dried specimens;—the perianth varies much in depth and amount of lobing;—the number of stamens varies in different flowers, and has no determinate relation to the lobing of the perianth;—anthers, mucronate and blunt, on the same catkin;—fruit-bearing peduncles, which attain their due length at the flowering period, and vary more on the same branch than do the petioles, differences of 1 to 3 being frequently surpassed;—number of fruits varies extremely on the same branch;—the form of the full grown cup is fairly constant, but the form of the base often varies, as from turbinate to hemispherical and from blunt to attenuated;—the gibbosity of the bases of the scales varies very much, their direction, which is always straight when young, becomes patent or reflexed in age, but mature normal cups are very constant in this respect;—terminations of the scales of the cup, in some species the upper scales of the cup elongate into a recurved narrow lamina; this character is not always constant, and Michaux asserts, that in dense forests after a hot summer, the scales do not elongate at all;—Acorn, its length varies much in relation to the cup, or rather, there are different epochs of maturation, at which acorns of different dimensions are produced; thus the Spaniards say that *Q. Suber* yields 3 crops, and the acorns of each have a different name. Be this as it may, nothing is more common than to find on the same branch acorns included and exserted from their cups.

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* M. De Candolle observes, that the question of species, their limits, modifications and origin has been neglected since the days of Linnæus. We cannot understand what is here meant; for not to mention Lamarck, and that very able but unsound work, the "Vestiges of the Natural History of the Creation," and the long train of treatises to which it gave birth, surely the works of St. Hilaire, Owen, Edward Forbes, Lyell, and numberless other men, show that these subjects have never been neglected.

† It should be borne in mind, that this so called branch, is nothing more than a twig, rarely exceeding 10 inches long, preserved for the Herbarium.

Again, M. De Candolle finds that certain characters vary according to the age of the plant; thus the leaves of young shoots of oaks are usually sharper at the base, less cut or toothed, and shorter petioled than those of old shoots, besides being of a very different form. Lastly, the duration of the leaves of one tree sometimes varies from year to year, according to the season.

The characters which M. De Candolle has never found to vary *on the same branch*, are, the size, pubescence, and to a great extent the form of the stipules; the direction, size, and to a certain degree the number of nerves of the leaf; the pubescence of the leaves and branches, the hairs being isolated or fascicled, their presence on the nerves and parenchyma, and their length on the young organs; the duration of the foliage; glabrous or pubescent anthers; the form of the upper part of the ripe normal cup; size of the cup; general form and relative size of the scales of the cup; annual and biennial maturation of fruit; position of atrophied ovules in the ripe acorn.

The above observations are probably the most accurate and important of their kind that have ever been brought together, and for them the thanks of Naturalists are pre-eminently due. Upon Palæontologists, especially, their study should be urgently enforced, for the very characters here authoritatively shown to be most variable *on single branches*, are most frequently the only ones of which the Palæontologist can take cognizance; whereas of all those pronounced constant, that of the nervation is the only one of which they can avail themselves; and it is to be borne in mind, that M. De Candolle only answers for the invariability of these last, *on the same branch*. Of course exceptions may be taken to any one of these results, and no other accumulation of specimens would give precisely equivalent ones to those M. De Candolle has obtained; but of their general accuracy we have as little doubt as there can be of the author's scrupulous care in observing and recording them.

Then follows a discussion upon the principles which M. De Candolle has attempted to follow in determining what to regard as species and what as varieties; in which there is, as he himself observes, nothing new, and they refer to points so obvious, that they seem hardly worth the dignified name of principles. One common practice he professes not to follow, viz. that of judging of the validity of a character in one species by analogy with others; he says, in short, given two specimens alike in every respect but one, and granting that one to be variable in other Oaks, I would still raise these two specimens to the rank of distinct species, till more specimens arrived to confirm or confute their claims. Such a practice we venture to think neither philosophical nor expedient; it is unphilosophical, because it excludes every consideration that experience, study, or sagacity suggests, and reduces the systematist to the condition of a dividing machine; and it is inexpedient, because we know that one character rarely, if ever, makes a species,—because synthesis is more often a safer process than analysis; and, because, if such a doctrine were carried out even in part, by one active systematic Botanist, synonymy would swallow up system in a very few years. Had such been Linnæus' practice, with his poor materials, every exotic specimen would have been a species; and if it really were M. De Candolle's, every variety not connected by known intermediates (even white and red-flowered races, &c.) must be ranked as distinct species. There are no limits to the evil consequences of such an abandonment of the reasoning faculties and idolatry of the observing powers. We will mention but one, namely, that all M. De Candolle's excellent principles, deduced from a study of Oaks, would be absolutely valueless as guides to the study of any other group of plants whatever. If the length of the petiole is known *as a rule* to vary from 1-3, in the individual branches of Oaks, surely common sense, no less than expediency, would indicate that two specimens differing by this character alone, should be ranked as varieties till they are proved distinct, rather than as species till they are proved the same, which is giving specific value to a character of which *all we do know is*, that it is that of many proved varieties, and of no other known species.

As it is, M. De Candolle regards *two-thirds of the* 300 *species of Oaks admitted by him as provisional species*, and adds that it is difficult to suppose that more than one-third of the published species of plants will prove to be fixed. The best known Oaks are those which present most varieties and sub-varieties, the maximum being in *Q. Robur* which has 28, *Lusitanica*, 11, *Calliprinos*, 10, and *coccifera*, 8. Moreover, the best known species are surrounded by provisional ones, which may one day be absorbed by them, four species thus differing little from *Robur*, and two being near *Calliprinos*, which touches *Q. coccifera.*

After some further comments on the variability of plants in general, M. De Candolle observes, "that the progress of science, no less than reflection, leads me to the opinion that the higher the groups are, the better they are limited; in other words, the fewer are the doubtful forms that are bandied about from one to the other." This is an old doctrine of M. De Candolle's, and being here repeated by him after many years experience, we have felt it to be our duty to weigh its merits well afresh, and have arrived at the same result as heretofore—that it is true in so limited a sense that it is better abandoned altogether. It is true, as he reminds us, that the divisions between Cryptogams and Phænogams, and between Monocotyledons and Dicotyledons are sharp and clear, but this amounts to no more than the establishment of three groups, under which the 100,000, or, according to some, the 250,000* known plants, are grouped. In the smaller division, the Cryptogams, the 3 great groups, Ferns and their allies, Musci and theirs, Hepaticæ and theirs, are further trenchantly limited, and these again from the remainder, or Thallogens, but between the members of these latter, Fungi, Algæ, and Lichenes, no limit exists, and assuredly the genera of each and all the groups of Cryptogams are incomparably more unstable than the species, variable as they are. In the Phænogams matters are still worse, the natural orders of Monocotyledons have never yet been grouped into well limited subclasses, nor have the orders been well limited themselves; most assuredly the species of *Gramineæ*, *Orchideæ*, *Liliaceæ*, *Irideæ*, and *Amaryllideæ*, are incomparably better limited than the genera of those orders, and these again than the tribes. Lastly, turning to the class of Dicotyledons, the classification of their natural families into subclasses is the reproach of systematic botany in the eyes of those who believe that these can be so grouped, and the despair of all who (with sufficient knowledge and experience) have tried to group them. As it is, there are no less than 5 methods in vogue in works of standard authority now publishing, followed respectively as De Candolle's and Lindley's in England, Brongniart's in France, Endlicher's in Germany, and Fries' in Scandinavia, besides others in less vogue all over the continent. Descending in the scale, we find such diversity of amount of limitability of the higher and lower groups between Species and Orders, that no general conclusions can yet be drawn; there is the great Order *Leguminosæ*, and its three sub-orders, all trenchantly limited, whose genera and species are, on the whole, all well limited and natural also, but which cannot be collected into tribes; in *Ranunculaceæ* the tribes and genera are well limited, but a large proportion of the species are most variable; in *Myrtaceæ*, the species are much better limited than the genera; in *Compositæ* the two suborders are well limited; but the tribes, subtribes, genera, and species, very badly; and, finally, in *Umbelliferæ* and *Cruciferæ*, two of the best limited Orders, the tribes, genera, and species are all unstable and indeterminable alike. Lastly, we may cite the experience of the authors of the "Genera Plantarum" for the fact, that of the 55 Orders contained in the first part of that work, the limits of fully three-fourths have been determined with very great difficulty, and only after a comparative study of many species of all the contained genera; that the totality of conclusions arrived at are in most cases opposed to the opinions of about half their fellow Botanists; and that difficult as the limitation of the Orders has been, it is trifling compared with that of the Genera; whilst the grouping of the Orders into cohorts is the most difficult, and (as far as regards the means of defining them, however natural), the most unsatisfactory of all. Their opinion is most decided that, *on the whole*, the natural grouping of individuals into species, and their limitation as such, is far more easy and satisfactory than of genera, and of all the other superior groups in the class of Dicotyledons, and this whether in the field or in the herbarium. And further, they have no hesitation in affirming, that were half the species of each genus, or half the genera of each Order to disappear from the earth, and the classification of the remainder to be reconstructed, the circumscription of both their Orders and Genera would be extraordinarily modified, but of their contained species not materially. No one who has not worked out generically a *consecutive* series of allied Orders, can have any idea of the number of genera whose claims to rank in one or the other are determined either by some merely technical character, of no apparent functional import, or by some natural character, quite undefinable by words. The fact that species do in botany stand out as the most prominent term in the series between individual and class, is perhaps the most salient obstacle to the reception of the doctrine of the origin of these through variation by natural selection.

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* M. De Candolle's estimate of Phænogamic plants in the "Géographie Botanique," but probably not that he now entertains.

Returning to M. De Candolle, this section concludes with some excellent remarks on hybridity, and the impossibility of testing, in many cases, the validity of species by experiments or observations on the permanence of characters during successive generations.

2.—*Observations and Hypotheses on the History and Origin of the Forms of Cupuliferæ.*

The discussion to which this section is devoted is one of the most interesting in the brochure, and is conducted in M. De Candolle's best method. The following is a specimen.

Beeches are found in both the Northern and Southern hemispheres; but all the other genera of Cupuliferæ, including the most numerous in species (Oak and Chesnut), are limited to the Northern. The exceptions are, a few Oaks which, advancing southwards, reach the mountains of New Grenada and the Indian Archipelago. The majority of Oaks and Chesnuts inhabit Mexico, the United States, the Mediterranean basin, and temperate Europe and Asia. Three natural groups of Oak are confined to Southern Asia, as are *Lithocarpus* and *Castanopsis;* one natural group is confined to California; whilst the largest group is European, Asiatic, and American.

Q. Cerris (the Turkey Oak) appears to be dwindling away, for in no other way can he explain the gaps in its distribution. It is found all over Asia Minor, Turkey in Europe, and thence continuously westward in the Bannat, Istria, and Lower Austria. Though absent in Greece and Zante, it occurs in the Apennines and Sicily, in the neighbourhood of Besançon, and in Western France. These isolated habitats of the Turkey Oak seem to imply its former continuous extension from Lebanon to the Atlantic border, and its subsequent local extinction, not only by man's agency, but through physical causes. When Oaks occur in isolated patches, due to the extension of the species, these patches appear under a different aspect; the localities are not so far separated, for acorns are not transported far by the wind or by birds; and further, M. De Candolle thinks he has demonstrated by his researches in the known naturalization of species in Europe and the Colonies, that extension is a rapid phenomenon—an invasion, in fact—and diminution a slow one. If *Q. Cerris*, therefore, were now invading Europe, it would appear at one time in one place and at another time in another, and its inroads would be all the more obvious from its fruit being a remarkable object, attracting the attention of the most ignorant observer. On the contrary, the abovementioned localities of *Q. Cerris* are few, and have been the same for the last fifty years.

The above is very ingenious, and perhaps true; but, far from convincing, it assumes too much at every step, and omits all allusion to disturbing causes. It assumes, 1. That the progress of migration of a tree must be continuous; from which it follows that all trees whose areas of distribution are not continuous are diminishing in those areas. 2. That birds do not carry seeds so large as acorns, which is open to doubt, seeing that Pigeons are granivorous, and moreover have been shot in tropical islands with whole nutmegs in their crops.* 3. That *Q. Cerris* must once have inhabited Greece. 4. Much exception may be taken to the assertion that extension is a rapid phenomenon and diminution a slow one, especially when applied to trees of long duration. 5. There is no confidence to be placed in the powers of observation of uneducated people, and still less in their opportunities of observing and in the chances of their observations being handed down. 6. The gravest objection of all to the whole method of treating the subject is, the involved assumption, that the dissemination of a species is an unaided process, depending solely on the plant's fecundity and favouring conditions of climate and soil; the struggle for existence is not recognised, the plant is supposed to grow where it likes best, not where alone other plants and animals will let it grow; the frail tenure upon which each lives and occupies the soil is overlooked, as is the fact that of the thousand natural causes which oppose the distribution of a plant, each is the sum of a thousand others whose subtle influences no man can estimate. Considering all these circumstances, strongly as we are inclined to adopt M. De Candolle's view of the diminution of the Turkey Oak, it is impossible to assign to his arguments the positive value he does.

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* On the authority of Dr. Jenner, in the "Philosophical Transactions," the Woodpigeon has been frequently shot on the Norfolk coast, having in its crop seeds of plants that are not cultivated in England. The Crow also is said to be an active agent in disseminating Oaks in Wales and Scotland; both the Hooded and Common Crow carry the acorns for many miles, and these grow where thus transported.

The case of the Beech is far better argued.

The Beech invades the forests of Denmark and Germany, where it supplants the Conifers, Birch and Oak. M. Vaupell attributes this to—1. a desiccation of the soil (perhaps due to the advances of cultivation); 2. to a preparation of the soil by the leaves of other trees; 3. to the Beech growing well under the shade of Birch and Pines, whilst nothing will grow under its shade.

M. De Candolle makes much of the obstacle presented by arms of the sea, in limiting the migration of plants, and especially of large trees, such as Cupuliferæ. He says: "The extension of the areas of a Cupuliferous plant, by the transport of its seeds across an arm of the sea, should be regarded as *impossible*;"* and he proceeds to observe that the present geographical distribution of species may fix the geological date of their extension in certain directions, or, inversely, the date of the separation of certain islands from their neighbouring continents. Thus he continues: "The Beech area extends westwards; that tree, though becoming more abundant towards the western parts of Europe, did not grow in Holland at the date of the conquest of that country by the Romans; it is wanting in the submerged forests of the Channel; its being indigenous in Great Britain and Ireland is doubted, on the strength of a remark of Cæsar's, and on the fact of its rarity except in plantations; nor is it found in English peat-bogs, where the Pine, Oak, and other trees abound: hence the ancient home of the Beech should be regarded, as M. Vaupell maintains, as the mountain region of Central Europe."

The Beech cannot withstand the heats and droughts of the plains of S. Europe; it is found in the mountains of Sicily above 3000 feet, and in Corsica, but not in the far loftier mountains of Sardinia, the French Atlas and the Sierra Nevada, which may be due to the dryness of the chains; so that the only conclusion M. De Candolle can draw is, that the establishment of the Beech in Sicily and Corsica antedates the period of the separation of these islands from the continent on the north. The Beech is absent as a native in the Azores and Madeira, but flourishes where introduced; whence he judges that those islands were separated from Europe before the Beech migrated so far westward. Lastly, he says, the Beech cannot always have been absent on the plains of Southern Europe, for it follows from its being found sporadically on the Pyrenees, in Corsica, on Etna and the

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* M. De Candolle is probably not aware that five plants of *Entada gigantiloba* were raised at the Royal Gardens, Kew, from seeds collected on the shores of the Azores, whither they had been transported by the Gulf stream from South America.

Apennines, that it once spread over the intermediate areas; the glacial epoch would have supplied the required climate for it to do so, and we thus arrive at the belief that cold caused by the northern glaciers, and the contiguity of Corsica and Sicily with the European continent were simultaneous, or more or less so.

From this and some negative palæontological evidence, confessedly however of no appreciable value, M. De Candolle concludes, that the Beech appeared in Europe, at the base of the Alps and Apennines, at the end of the tertiary epoch only, in the long interval which followed the elevation of the Alps, and preceded the separation of Sicily and Corsica from Italy; thence it spread to Holland, Normandy and the British Islands, since the Roman epoch only; and lastly it is becoming more common in our time in Germany and Denmark.

The history of the Chesnut is similarly treated, as follows:—

Its history is analogous to that of the Beech in Europe. Its northern limit is Belgium on the west, Styria and the Crimea on the east; it shows no inclination to spread in England, if indeed it was ever wild there, which is more than doubtful,* and is undoubtedly absent in Ireland and the Azores. It is registered as a native of Madeira and the Canaries, but evidently cultivated specimens have been taken for wild ones. It abounds in the south of Europe, Sicily, Sardinia, and Crete, as well as in Asia Minor; it must have established itself in these islands before their separation from the continent. Its abundance on the mountains of Grenada renders its absence in N. Africa most remarkable, since the climate of Algeria is identical in the east with that of Sicily and Sardinia, and in the west with that of southern Spain. Hence we arrive at the only two possible hypotheses, either that an arm of the sea prevented its migration from Europe to Africa, or that if it once did inhabit Africa, it has since been destroyed there, of which hypotheses the first appears to M. De Candolle the most probable.

After alluding to the absence of the genus *Castanea* in the tertiary rocks, and more recent European deposits, and in the island of Cyprus, M. De Candolle proceeds to state, that the European Chesnut inhabits two other regions, China and Japan, and (a variety of it) the United States, but that it is absent in N. W. America, and over a large area of Central Asia. It thus has three centres, of which our own and the Eastern Asiatic are ancient; for the first antedates the present condition of the Mediterranean basin, and the second antedates the separation of Japan from the American continent; and further the existence of four distinct varieties of the tree in Japan, besides the European form (also present), indicates its antiquity there. Lastly, the American form extends from the mountains of Carolina to the plains of Maine and Michigan, and there are no grounds for speculating on its relative antiquity.

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* We suppose that there can be no doubt that it never was indigenous in the British Islands.

So much for the facts; to apply them, M. De Candolle reverts to the well known hypothesis which originated with Darwin we believe, (which, however, he attributes to Heer and A. Gray), that the N. circumpolar regions when warmer than now, were also more closely united than they now are, and were peopled by a temperate Flora, which was driven southwards in various longitudes by the cold of the Glacial epoch; and continues to observe that the chesnut probably originated in the Chinese and Japanese regions. It was absent in the hypothetical Europeo-American continent, the Atlantis of Heer, which was probably separated from America at an earlier date than from the south of Europe. At the close of the tertiary epoch, when Europe was continuous with Western Asia, the chesnut could extend on that side westward into Europe, and advance towards the Alps, whence it proceeded southward to Spain, Corsica, Sardinia and Sicily, islands which were then conterminous with Europe, as they certainly were during the Miocene epoch. These tracts were, however, already separated from Africa before the arrival of the chesnut tree. The Azores, Ireland and England being also separated, the species could not spread farther west. The most doubtful point is, whether the chesnut ever lived in central Asia, between its present habitats of China and Asia Minor. In the present state of our knowledge we have no data to guide us to any conclusion on this point.

The discussions on the common and evergreen oaks are as interesting as the above, but hopelessly involved, these species being more common, more generally distributed in certain directions; and further, being surrounded by satellites of closely allied or doubtful species, and nearly connected with fossil tertiary species, in Europe and elsewhere, giving rise to whole trains of complicated fragmentary considerations (in which the Atlantis continent plays a large part), through which we do not see our way clearly to any result; and as nothing short of a full, literal translation, too long for the pages of this review, would do justice to the discussion, we must refer our readers to the essay itself, assuring them that it is well worth a careful study. It need hardly be remarked, that all the force of the above line of reasoning depends on the establishment of M. De Candolle's doctrine that birds cannot carry acorns, chesnuts or beech nuts across an arm of the sea. The fate of continents and islands seems to hang, according to him, on this slender thread.

The remainder of M. De Candolle's essay is occupied with his opinions and reflections upon the "Systéme de M. Darwin," which he considers to be the most ingenious and complete of those based on the theory of the continuous evolution of organic beings. In this, however, there is nothing novel, and his grasp of the doctrine is feeble compared with that of its two great expounders, A. Gray and Huxley, which are well known in this country. Such as it is, it proves that the many considerations connected with the geological history, development, distribution, variation and classification of organized beings, which have for a quarter of a century been familiar to the naturalists of this country, thanks especially to the writings of Lyell, Darwin, and E. Forbes, are slowly making their way on the Continent; and it is no small gratification to find that they assume that importance in this essay of M. De Candolle, which it was thought they should have held in his learned "Géographie Botanique;" and such being the case, we are not disposed to cavil at the impression which the essay too much conveys, that many of these considerations, and even the most trite of his conclusions, are original on its author's part, and suggested for the first time to his mind by a study of the Cupuliferæ.

It remains, however, to give these conclusions, all important as some of them are, and familiar to English naturalists, in the words of their author. He says, "To return to this work, in which secondary and minute observations have led me by degrees to the consideration of the most important scientific questions, I affirm—

"1. It is not impossible, by means of numerous well selected specimens, to establish in Botany groups comprised one within another, of which the lowest series are very numerous, very badly limited, forming subvarieties, varieties and races, by means of characters often varying in the same individual; the so-called varieties or races being grouped in species a little less vaguely limited, the species forming sufficiently precise genera, insomuch that all mankind have recognized these generic groups and given them substantive names (as oak, poplar, gentian, &c.). Lastly, those genera form groups which themselves are comprised in others." (As before stated, we take exception to every term of this proposition, except the self-evident first,—that plants can be grouped, and the last, that genera may be grouped as well as species, &c.)

"2. Many of the groups found in books are doubtful and provisional, especially those of the lower degrees, for they are founded on a few specimens, or on analogies and presumption, and not upon numerous specimens."

This is true as far as it goes, but not the whole truth; nor are the causes altogether relevant; were they so, the Systema of Linnæus would be one of the worst systematic works, instead of the best.

"3. There is a tendency to hereditariness of forms and functions in all these groups, even the lowest, which affects the most trifling character, but it is never complete or uniform, and there are always differences either very slight, or slight, or considerable, which are either transitory or permanent, between one generation and the succeeding.

"4. Existing geographical distribution, combined with the study of fossil plants of the modern epoch, reveals frequent changes in the limits of varieties, races and species, according to successive physical or geographical circumstances, but unaccompanied with appreciable changes of form or of function.

"5. Going back to the tertiary epoch in Europe, we may assume that there have been changes of form over and above the changes of geographical distribution, because of the existing distribution of very analogous species, the length of time that has elapsed, and the impossibility of specifically identifying the present vegetation with that of the tertiary period.

"6. The theory of a succession of forms being derived from earlier ones, is the most natural hypothesis, explaining best the known facts of palæontology, the geographical distribution of plants and animals, their anatomy, and their classification; but it wants direct proofs, and if true it must have acted so slowly, that its effects are appreciable only after a lapse of time long preceding our historical epochs.

"7. In the present state of science, it is not easier to define a species than it is a genus or a family. All the definitions given are inapplicable; the worst is that of Linnæus, who, however, comprehended better than any other naturalist the construction of the higher groups, varieties, and races, and who gave the name of species to that category of groups; a fact which should oblige us to restrict it to the sense he adopted."

M. De Candolle is no doubt right in saying that every definition of a species is false, though he does not seem to appreciate the fact, that it is impossible to define what is (as he everywhere confesses) in its origin unknowable and in its essence illimitable; he is, however, unintentionally no doubt, unjust to Linnæus in quoting his aphorism, "Species tot numeramus, quot diversæ formæ in principio sunt creatæ," as his definition of species. If M. De Candolle will refer again to the Philosophia Botanica he will find that these "characteres" are in no way given as definitions, but are expressions of facts in the author's opinion, and in so far as species were concerned, of the opinion of every cotemporary author: it would be as inaccurate to call the preceding aphorism a definition, viz., "Filum ariadneum Botanices est Systema, sine quo Chaos est res herbaria," or that again preceding, "Systema classes per appropriata membra resolvit: classes, ordines, genera, species, varietates;" and not only are these in no way given as definitions, but the sagacious Swede everywhere so obviously avoids attempting the definition of the term species, that it is difficult to understand how any one familiar with the logical method of Linnæus's mind, as evinced in all his writings, could attribute to him so grave an error of judgment, as to propound a statement of fact for a definition. For a nearer approach to a Linnæan definition we may quote the lines that follow the aphorism quoted above, and which involves as good a definition as any, and the essence of that so ably expressed by the elder De Candolle.* Linnæus goes on, "Species tot sunt, quot diversas formas, ab initio produxit infinitum Ens ; quæ formæ, secundum generationis inditas leges, produxere plures, at sibi semper similes. Ergo species tot sunt, quot diversæ formæ s. structuræ hodienum occurrunt,"— and the same facts are stated in much the same words in the Ratio Operis of his Genera Plantarum.

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* This is to our mind the best definition extant. "Nous réunissons sous le nom *d'espèce* tous les individus qui se ressemblent assez entre eux pour que nous puissions croire qu'ils ont pu sortir originairement d'un seul être, ou d'un seul couple."—*Phys. Vég.* ii. 688.

It is difficult to draw from M. De Candolle's Essay any positive conclusion as to whether or not he has become a convert to Mr. Darwin's theories of evolution and natural selection; though his sixth conclusion binds him to the acceptance of the doctrine of evolution, as far as any naturalist, even Mr. Darwin himself, can feel bound by a theory built on circumstantial evidence, which from its very nature never can be proved: —to the subject of natural selection he does not allude in his concluding remarks :—with regard to the slowness of the operation of an assumed creation by evolution, upon which he dwells, this is a point upon which Darwin insists as strongly as any one ; and lastly, with regard to the absence of direct proof, which M. De Candolle puts forward as a desideratum, he elsewhere avows that the alternative doctrine of original creations is incapable of direct proof; so that putting all three considerations together, he seems logically driven to the acceptance of evolution as the only hypothesis which in the present state of science is tenable. However this may be, it cannot but be gratifying to British naturalists to recognise the enormous change of opinion, and, as we really think, advance in philosophical views and range, which this essay manifests when contrasted with the otherwise admirable Géographie Botanique of the same author, published only eight years ago, and to attribute it, as they must, to the influence of the writings of the exclusively English school, founded by Lyell, Darwin, and E. Forbes.

XV.—On Welwitschia, a new genus of Gnetaceae. By Joseph Dalton Hooker, M.D., F.R.S., &c. (Transactions of the Linnean Society, xxiv. 1.)

Our botanical readers must well recollect the lively curiosity excited on the publication of Dr. Welwitsch's letter to Sir William Hooker, dated from Loanda, August, 1860, in which he first told us of the very extraordinary production with which his name is now associated by Dr. Hooker. Very various were the guesses hazarded as to its probable affinities. Guesses they could only be from the brief and insufficient account which Dr. Welwitsch was at that time in a position to give of his wonderful discovery. It might be some uncouth monocotyledon ; in its hexandrous 'bi-sexual' flowers allied to the Lilies, or, in its amentiform inflorescence to the Sedges. But the vegetative system of the plant offered then the most profound enigma. Dr. Welwitsch described it as with an obconic woody trunk, having a disc-like top, 1—5 ft. in diameter, from the opposite margins of which spring a single pair of leaves, each often several feet in length and persisting through the life-time of the plant; which life, he said, might extend over a century. These leaves, according to this botanist, are the original cotyledonary leaves thrown up at the time of germination. Dr. Welwitsch expressed the opinion, that the new plant would probably turn out to be ordinally distinct from anything previously known, and suggested that the genus based upon it should bear the name *Tumboa,—N'tumbo*, being the name by which, he stated, it was known to the natives.

Not long after the receipt of Dr. Welwitsch's letter, flowering cones of the plant, together with a coloured drawing of it, were received by Sir William Hooker from Mr. Baines, an artist then travelling in the Damara Land, and as, shortly after, specimens were received from the original discoverer Dr. Hooker was able to exhibit the plant and to explain the more prominent peculiarities which it offered, at the closing meeting of the Session 1861-2, of the Linnean Society. Late last year, a valuable series of large specimens were obtained through the offices of Messrs. Monteiro and Andersson, enabling Dr. Hooker to continue and extend his previous rather restricted observations, and presenting also some additional particulars of interest. At the first meeting of the current Session (1862-3) of the Linnean Society, Dr. Hooker confirmed Welwitsch's opinion that the leaves were the persistent cotyledons, and his examination of the flowers, he stated, had led him without hesitation to refer the plant to the group Gnetaceæ, to which, indeed, he had assigned it on its first examination. This opinion as to its affinities the elaborate memoir now before us wholly substantiates. The name Dr. Hooker proposes, with Dr. Welwitsch's sanction, should be altered to *Welwitschia*,—Tumbo being applied by South African tribes to various plants of dwarf stature.

Welwitschia, is found on and near to the Western coast of South Tropical Africa, about half way between the Equator and Cape. It was first discovered by Dr. Welwitsch near Cape Negro, on a plateau 300—400 ft. above the sea. Mr. Monteiro found it at Mossamedes, near the same place, and states also that he met with it on a journey inland upon a perfectly dry plain, bare of other vegetation excepting a little short grass. It was generally growing near the ruts worn by running water during the rainy season. The Portuguese at Cape Negro told him that some of the largest specimens grew on the banks of the Croquis river. Mr. Andersson, writing to Sir W. Hooker from Damara Land, says, he has found it only on the "desperately arid flat stretching far and wide about Waalvisch Bay," between 20° and 23° S. lat.; most common, however, about the lower course of the river Swakop.

Welwitschia is excessively ugly, and one might, apart from its leaves and flower-branches, pardonably take it for some huge fungoid growth. Indeed, as Dr. Hooker observes, the lobes of its crusty disc much resemble masses of the common *Polyporus*, used by school-boys as touchwood. Without attempting to give a detailed description of the plant here, which it would be impossible to render intelligible without copious drawings, we shall indicate and briefly comment upon some of the main exceptional features which it presents. The general aspect of the trunk first strikes the attention. It is, as was described by Welwitsch, obconical with a flattened or concave top. The largest specimens which have as yet reached England, measure about 2 ft. in length and 4½ ft. round the discoid top, one specimen weighing about 30 lbs. Many dry, leathery, tattered ribbons hang all round the margin of this disc, which, when the plant was growing, was raised but a few inches above the level of the ground. Examining these thongs more closely we find that they are, as the discoverer describes them, really but one pair of leaves split up longitudinally. The thongs sometimes separate to the base, and are then further removed from each other by interstitial growth of the circumference of the stock; but examining a suite of specimens from the youngest sent home, there can remain no doubt that usually they are referable to but a single pair of leaves, and that this pair is persistent. It remains to be demonstrated by actually germinating the seeds, that they are in reality the cotyledons of the embryo, but we think Dr. Hooker is quite justified in telling us there can be little doubt that such is the case.

The bases of these dry leaves are enclosed in two horizontal grooves of 1 in. in depth, closely fitting and clasping the leaf. Each groove extends about half round the periphery of the disc. In one of the youngest examples received, with a diameter not exceeding 1⅝ in. the leaf-grooves are already about ½ in. deep.

This singular structure of axis and leaf constitutes a very remarkable feature. The internal anatomy of these organs, also, is as anomalous and unlike aught previously known, as any dream could picture. The lower portion of the older specimens, where it tapers down into the long tap-root, resembles, when vertically torn in twain, a mass of hempen yarn. Higher up in the thick part of the stock, where the cellular tissue is less decayed and living, the wood is firmer, though largely made up of the hempen element (the bast, or liber-layers) of the vascular bundles, which twist and twine in any sectional face, apparently in every direction. But if the vertical section be more carefully made, say at right angles to one of the leaves, and at a little distance within the margin of the disc from which it is given off, some order is recognisable, especially along a stratum about an inch or so below the crown or surface of the disc. This stratum consists of the distinct closely packed laterally compressed vascular cords left behind by the leaf-base as it became removed from the centre. These cords are continuous directly into the leaf, and form the unbranching veins which run along it, though unseen from the surface. From this stratum which is usually more or less cup-shaped, and nearly equidistant from the surface of the crown, bundles are given off into the crusty mass above, from which the flower-stalks arise, and below into the mass of the stock and root. The course of these we cannot here follow; we shall have occasion to recur to them and to the histology of their tissues. The crown just referred to, is pitted with the scars of fallen peduncles scattered along rudely concentric ridges. Each ridge clearly corresponds to a period of growth, and they are thrown off, the older successively nearer the centre, from the leaf-bases, which constitute the peripherical growing zone of the stock. The inflorescence may be said to originate in the axils of the leaves; though some curious considerations suggest themselves in connection with its origin, for we find the peduncles scattered along the outermost ridge at irregular intervals, originating apparently at different times. Are the flowering branches adventitious? Or is there good ground for entertaining the suggestion Dr. Hooker throws out, that possibly each vascular cord of the leaf may represent an independent organ, and that the leaf may be in reality made up of a multitude of leaves laterally coalesced into one broad ribbon? In the latter case the numerous peduncles might each be subtended by their own leaf-representative. From the mode in which the buds of the inflorescence originate, and from the circumstance Dr. Hooker calls attention to, of their occasionally springing from the side of the stock under the leaf-insertion, we think it not improbable that they are, at least in a limited sense, adventitious.

The inflorescence consists of short forking branches bearing numerous cones of closely imbricating decussate scales, in the axils of which scales the compressed flowers are borne. And in the structure of these flowers we find, perhaps, yet greater source of wonderment. There are two kinds of cones,—one kind with a female flower in the axil of the scales, the other with flowers structurally bi-sexual, but functionally male. The latter are the smaller. It is probable the plants may turn out to be dioicous, bearing only one kind of cone, ♂ or ♀; but this is not yet certainly known. The female flower in all essentials resembles that of the old genera *Ephedra* and *Gnetum*; the male, or quasi-hermaphrodite, is something quite unique. It consists of a perianth, like that of the male of *Ephedra*, which encloses six stamens, united by their filaments into a short tube. The anthers burst by a tricrural slit. In the centre of the flower, immediately within the staminal tube, rises apparently a pistil, terminated by a slender curved style and discoid stigma. The question arises, Is this a pistil or a naked ovule? To this question we shall return. Meantime cutting open the pistiliform body we find it encloses the conical nucleus of the ovule. This has no embryo-sac, and it is never impregnated.

We find, then, the chief anomalies of *Welwitschia* to consist in: —1. The form of the trunk, resulting from the non-development of a vegetative axis in the plant after germination; 2. The persistence of the seed-leaves; 3. The central organ of the staminate flower, representing the gynoecium of hermaphrodites; and 4. The internal anatomy and histology of the plant, especially of the stock and leaves.

As the process of germination has not yet been followed out, we shall not attempt to supply hypothetically the details of development which have resulted in conditions so anomalous. With regard to the form of the trunk, the non-development of vegetative axes and the persistence of the cotyledons, we hope that before long Dr. Hooker may be in a position to furnish a supplement to his Memoir, describing the details of germination, and settling the difficulties which it is now a waste of time to speculate about, especially as regards the nature and origin of the crown of the stock from which the flower-stalks spring.

A consideration of the central organ of the 'hermaphrodite' flower suggests matter which may detain us a short space. We have noted this organ as one of the most anomalous features of the plant. It is the only case of a 'gymnospermous' plant with structurally hermaphrodite flowers; or, to put it differently, the only plant with hermaphrodite flowers which are at the same time destitute of carpels. So far it is highly interesting. But the question which it recalls is of greater interest. It is one which has of late been prominently before botanists mainly through the recent endeavour, on the part of a young French observer, to controvert, upon organogenic grounds, the generally accepted view, first advanced by Robert Brown, of the morphological equivalent of the envelopes of the ovule of Gymnosperms. It is a question which applies not to *Welwitschia* only, but to the whole group of so-called 'Gymnospermous' plants, which we have been accustomed to regard as characterised by naked ovules—ovules not protected by a carpellary covering from the direct contact of the pollen.

It stands thus:—What is the morphological equivalent in other flowering plants of the integument of the ovule in 'Gymnosperms'? Is it (1) the equivalent of a carpel or carpels? or (2) is it the equivalent of the coat of the ovule of angiosperms? We may add, or (3) is it a structure morphologically distinct from both of these?

Many were of opinion that the hermaphrodite flowers of *Welwitschia* might enable us definitely to solve the problem; but in reference to the evidence bearing upon the question at issue afforded by this plant we copy the following paragraphs from Dr. Hooker's Memoir:—

> "There is nothing in the development of this ovule that favours the theory that the integument of the nucleus in Gymnospermous plants is of carpellary origin, except the singular form and relative position of that organ in the hermaphrodite flower. In position, texture, structure and development it entirely resembles the coat immediately investing the nucleus in all other Gymnosperms; like these, and unlike carpellary organs, it is entirely devoid of vascular tissue in its substance, and of conducting tissue in its styliform prolongation; unlike a carpel it rises symmetrically round the nucleus, and in the hermaphrodite flower presents a symmetrical terminal disc, and it ceases to grow long before the maturation of the seed; and still more unlike a carpel it is carried up with the growing seed till its base is

> on the apex of the latter. In all these respects, except in the long styliform process, it accords with the inner ovular integument of phænogamic plants, which, indeed, have not unfrequently tubular orifices prolonged through the nucleus, though not so far as that of *Gnetaceæ.*
>
> "To these considerations must be added that of the exterior integument of *Gnetum,* which is as clearly an appendage of the ovule as the interior, but which must be considered to be either staminal or a production of the disc, if the inner coat is considered as carpellary.
>
> "Lastly, ovular integuments are singularly uniform in their structural anatomy, which seldom deviates from one common type ; and, in the normal condition of the ovule, it is devoid of appendages, or of other external or internal characters whereby those of allied species, or even genera or orders can be distinguished from one another. I am not aware that a single natural family or genus of Angiosperms presents any structural peculiarity of the outer or inner coats of its ovule : on the other hand the carpel is of all the floral whorls one of the most various ; and, as often happens with other organs, the more reduced it is, and the more it deviates from the foliar type, the more liable it is to vary : whence it is all but inconceivable that the ovular integument of Gymnosperms should be carpellary, and yet constant in structure." (p. 30).
>
> Again :—" The ovule of the hermaphrodite *Welwitschia,* with its tortuous styliform process and stigma-like apex, is the same in structure and appearance with the ovule of *Ephedra,* differing only in wanting the embryo-sac and in the stigma-like disc of the latter being narrow-oblong and not papillose." (p. 23).

We do not find, therefore, that the special evidence of *Welwitschia* serves as the basis of any argument in the case deserving to be maintained independently, *i. e.*, apart from other arguments derived from the rest of the 'Gymnospermous' group.

Any enquiry into the relations of the ovular integuments involves, to a certain extent, the consideration of the organ supporting or subtending these ovules. For it is quite conceivable that a carpellary leaf may occur as an open organ and not, as in Angiosperms, absolutely enclosing the ovule. And this seems the more likely since all are agreed that in Gymnosperms impregnation takes place by the application of the pollen directly upon the nucleus of the ovule, and not as in Angiosperms through the intervention of the stigma and conducting tissue of a carpel or carpels. In Angiosperms, moreover, cases do occur of the carpels opening so as to expose the young seeds, though never, so far as is known, are the ovules exposed prior to impregnation.

Such being the case, it is not a question of whether or no the term *Gymnosperms* should be maintained. It is, as we have stated, simply a question as to the equivalent of the ovular integument in the two groups of Dicotyledons respectively, or, to heighten the contrast, —the equivalent of the ovular integument of Gymnosperms in all other flowering plants.

With regard, then, to the organ, subtended by the bract-scale, which supports the ovules. If we take the very young female cone of a pine or larch, we shall find no difficulty in satisfying ourselves that the scale-like leaves of the stalk supporting the cone are serially continuous upward along the axis of the latter, where they subtend the organs from which the ovules arise. There can, therefore, be no hesitation in regarding these subtending leaves as bracts, in every way equivalent to the bracts of other flowering plants. The organ contained in the axil of each of these bracts is quite unlike anything else in the Vegetable Kingdom, and from a consideration of its matured condition only it might be regarded as (1) a modified branch, as (2) the modified leaf or leaves of an axillary arrested bud, or (3) as an open carpel or pair of carpels. Its development from its first appearance as a minute compressed mammilla, has been traced, and so also has been the development of the ovules and their integuments upon its inner surface. Developmental history has not as yet thrown any certain light upon the homology of this axillary scale. Two distinguished German botanists, Profs. Braun and Caspary, however, think they find this light in a monstrous condition to which the cones of some of the Pine tribe (especially the Larch) are subject. In these monstrous cones the hardened ovule-bearing scale is metamorphosed into an axillary shoot through a series of gradations showing, according to Caspary, that the scale is made up of the first pair of leaves of this undeveloped shoot, the leaves becoming connate, laterally dilated and woody. According to this teratological evidence, therefore, the ovuliferous scale is foliar. In so far it may be the homologue of the carpels of Angiosperms. It appears to us, however, that this evidence is by no means satisfactory. Admitting that the scale is a modified condition of the rudiments of an axillary bud, we see no sufficient reason why the lower portion of the scale, which bears the ovules may not be axial rather than foliar, since Caspary himself admits that the hooked appendix arising from the upper surface and near the middle of the scale indicates the apex of an evanescent axis.* For notwithstanding many arguments to the contrary, urged especially with much force and skill by Caspary,† we fail to see why, at least in some cases, the ovule may not be an axial rather than a foliar production. In *Gnetum* and *Welwitschia*, there appears to us no room for doubt on this head. Dr. Hooker observes in respect to it (in *Welwitschia*) "it is organically absolutely terminal, being erect, central, and continuous with the axis of the perianth without constriction, both in the male and female flowers."‡ We are not without a rather strong opinion that the embryo-sac and its contained embryo and endosperm actually becomes deeply invaginated in the extremity of the axis in *Welwitschia* and *Gnetum*, and probably many other genera of Gymnosperms; as the vascular cords traversing the sides of the seed-coat up to the level of the calyptiform cap (in the two genera named) would indicate. In the 'hermaphrodite' *Welwitschia*, where the ovule is not impregnated, the calyptriform integument never becomes elevated. Although it remains uncertain whether or not the scale be the equivalent of a carpel, it does not necessarily follow that Gymnosperms must be deprived of a carpellary homologue. For if, in the case of the Larch and its allies, the ovule arise from an axial organ, the integument of the ovule may still be the equivalent of the carpel or carpels, as Baillon and others hold. If it be *not* carpellary then carpels are wholly suppressed. Leaving the question of the homology of the ovule-bearing scale, which we think a consideration of many other Gymnospermous genera (especially of the groups Cupressineæ and Taxineæ) must show, need not form a very important element in the enquiry, let us briefly turn to the integument of the nucleus. Baillon and Dickson describe this integument as originating in two distinct lateral lunate elevations, one on each side of the small area to be occupied by the future nucleus. It is not clear whether the nascent nucleus or these lateral organs appear first. Much importance is attached to priority in the order of their development by both Baillon and his associates, and by Caspary. Baillon asserts the lateral organs rise first, but his figure scarcely supports him. It is difficult to believe that in this case it will ever be possible to obtain evidence of any real value. For granting that in all or nearly all cases examined the carpels appear before the ovule in Angiosperms, an exception is quite conceivable to any rule in vegetable organogeny, and an ovule appearing before its carpel need not surprise us. Indeed, Dr. Hooker shows that the nucleus of the ovule of *Welwitschia* actually appears before the perianth.* A more important point is the circumstance of the ovular integument originating in two distinct processes and not as a continuous ring in *Abies*. This affords to Baillon his strongest argument in favour of the integument being carpellary, each lunate ridge being a nascent carpel. The ovule thus becomes enclosed in a dicarpellary pistil, which terminates above in two prolongations representing styles. Caspary, in what appears to us the most important passage in his essay on the 'Female Flower of the Abietineæ,' satisfactorily shows, however, the weakness of this evidence in favour of the compound nature of the ovular integument; showing that in some other Coniferæ this integument is irregularly lobed, and, indeed, in the Larch, originates after the nucleus as a uniform surrounding ring, precisely corresponding in development with the ovular coat of Angiosperms. We cannot, therefore, admit on any organogenic or teratological grounds which have been hitherto advanced, the carpellary character of the ovular integument,—especially, if (to quote Dr. Hooker's words, p. 31), "we assume the ovular integument of Gymnosperms to be carpellary, we must admit, first, that it has neither the form, structure, nor functions of an Angiospermous carpel; secondly, that it has those of an Angiospermous ovular coat; and, thirdly, that while the carpel is a singularly varying organ in the genera and even species of Angiosperms, it is a singularly uniform one in those of Gymnosperms."

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* *Vide* N. H. R. ii. 25. (Dr. Thomson's translation.)

† Dr. Caspary seems carried a little too far in his indignant polemic against the French organogenists. The view which he upholds regarding the foliar relations of the ovule-coats of Primulaceæ, seems to us untenable, and we think essentially the same homology might have been argued for on more plausible grounds.

‡ Page 30.

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* Conf. pl ix. figs. 1—9.

But the question still remains. Is the ovular coat of Gymnosperms the equivalent of the ovular integuments of Angiosperms? If not, what is its nature? And can we indicate its equivalent in any other group? Unfortunately, we know almost absolutely nothing of the homology of the ovular coat in Angiosperms. And of the little which we do know much is derived from teratological evidence which requires to rest on a broader basis of data than has as yet been forthcoming, to be of material value. As shown by Braun* and Caspary† this evidence would appear to favour the foliar nature of the integuments of the ovule in Angiosperms: the nucleus, which these integuments surround and in which the embryo-sac is developed, being an entirely new and superadded structure.

But few cases have been recorded of oolysis, or monstrous ovular development, with the care which is demanded to be serviceable in the settlement of a question of this kind. Caspary, with Braun's well-digested report upon the nature of the ovular integuments before him, describes, with the minutest detail, a case of monstrous white clover in which the ovule-coats were found in various stages of degradation from those of the perfect ovules to leaflets of the characteristic trefoil leaf, into which latter the carpel was transformed and upon which no trace of the nuclear innovation remained. The nucleus was the last to disappear, and remarkably enough, it was found—in ovules the inner coat of which had assumed a foliar condition—upon the cellular tissue of the leaflets quite removed from the midrib or lateral veins. Now, while we cannot safely base an opinion upon such and similar cases, we are willing to grant that there is some probability attaching to the view of the foliar nature of the ovular integument in Angiosperms in many, if not in all cases. In Gymnosperms, on the other hand, at least in *Welwitschia* and *Gnetum*, the development, structure and general relations of the ovule-coat appear to us to indicate an origin analogous to that of the so-called *disc* in many flowers, and other axial developments, including the calyx or 'calyculus' of Loranthaceæ, Santalaceæ, and perhaps several other Orders.

We are scarcely prepared at present to enter upon an argument in support of this view. A detailed discussion of it would be out of place here. We may just observe that no reason occurs to us why the integument of the ovule may not differ in its morphological signification in different groups,—at least in Angio- and Gymnosperms, — since we are familiar with a case of substitution of an axial for a foliar development in the other parts of the flower. The nature of arilloid growths, too, should not be neglected in this inquiry.

Our space compels brevity upon the internal anatomy and histology of *Welwitschia*. Dr. Hooker regards the structure of the stem as presenting a modification, hitherto unique, of the exogenous plan. This modification, which gives it, *prima facie*, somewhat of a monocotyledonous character, consists in a large proportion of the descending bundles remaining closed, and thus isolated in the largely developed parenchymatous matrix of the stock. This isolation, together with much irregularity in the course of the bundles arises, no doubt, from the very peculiar conditions of the plant, the 'stock' of which we regard with Dr. Hooker, as the enlarged *tigellum* of the embryo.

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* "Ueber Polyembryonie und Keimung von *Caelebogyne*," pp. 188-197.

† Schrift. d. Physik. Gesell. zu Königsb., Jahrg. ii. p. 65.

As the Vegetable Kingdom does not afford us a parallel case of a tree thus reduced to its 'simplest expression,' we cannot institute comparisons, nor even indicate how far, under like conditions, any other woody perennial might be similarly affected. Dr. Hooker illustrates his view of the probable mode of development of *Welwitschia* by a reference to the curious case of *Streptocarpus*, a biennial or annual, with one persisting cotyledon and a 'plumulary' formation apparently analogous to that of the 'crown' of *Welwitschia*. But *Streptocarpus* is herbaceous, and the arrangement of its vascular cords has not been described. It is remarkable, however, that the best known cases of life-long persisting cotyledons should both be furnished by South African plants.

We have alluded to the extraordinary development of the liber or bast element of the vascular cords. The cells of this liber exhibit a kind of marking, indicating some peculiarity in the deposition of their thickened walls, which we have not seen elsewhere. The markings are directly transverse and exceedingly close together. The structure of the vascular cord is most readily examined in the leaf, and a cross section, showing a few of these side by side in the median line of the leaf is a most beautiful microscopic object. In respect to their composition, Dr. Hooker notes in the leaf, that they are bounded both above and below by a liber-crescent. The liber on the lower side is apparently developed from a narrow belt of 'cambium' cells on the same side of the vessels, which latter occupy nearly the centre of the bundle.

Perhaps the rigid spicular cells, which occur scattered through the parenchyma of almost the entire plant, afford its most remarkable histological feature. They are usually very thick-walled, much larger than the surrounding cells in diameter, often branched or hooked, and their external surface is more or less clothed with minute rhomboidal, or shortly prismatic crystals of undetermined composition. This occurrence of crystals on the outer walls of cells forming part of a tissue is extremely rare. But a single case has come to our knowledge, in a fragment of wood, of unknown origin, formerly in the possession of the late Prof. Quekett. We shall be curious to learn from the chemists what these crystals are composed of.*

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* Since the publication of Dr. Hooker's Momoir, Col. Yorke has ascertained that these crystals consist of carbonate of lime. The circumstance that they are

In this notice we have entirely passed over the interesting phenomena of the embryogeny of *Welwitschia*, which is largely illustrated by Dr. Hooker. These correspond in the main with what has been observed in Gymnosperms. *Welwitschia* presents, however, one very remarkable and exceptional feature in the secondary embryo-sacs, which grow out of the primary embryo-sac into the tissue of the nucleus above, where they encounter the descending pollen-tubes and are fertilised. Perhaps at some future time we may return to a discussion of the embryogeny of this plant, in connection with that of *Gnetum* and other genera, not Gymnospermous, which present some points of analogy with them.

In conclusion, we must express our gratification that it has fallen to the lot of a botanist, so distinguished by experience, and great philosophical attainment, as Dr. Hooker, to unfold this very extraordinary object the first to our view. No time has been lost in presenting to the scientific world the memoir which has been so anxiously awaited. The execution of it bears ample testimony to the faithful endeavour of its author, to render it worthy in every way of the rare occasion. We must not omit either to express our high satisfaction with the admirable execution, by Mr. Fitch, of the numerous plates which illustrate this memoir.

XVI.—The Antiquity of Man from Geological Evidences; with Remarks on theories of the Origin of Species and Variation. By Sir Charles Lyell, F.R.S. 8vo. London: Murray, 1863.

Until the great antiquity of this Earth was admitted, Geology could hardly be treated as a science, and as long as we endeavoured to compress the history of Man into the narrow limits of six thousand years, the atoms of truth which we possessed were unable, for want of space, to arrange themselves in their proper order. Realizing the difficulty, Zoologists, more or less boldly, hinted at a diversity of origin; Philologists took refuge in the Tower of Babel; and Archæologists abandoned in despair all hope of ever reconstructing the past. Of late years, however, science has made immense progress, and although with singular disregard for truth, and scanty reverence for the book which we profess to venerate above all others, we still place at the commencement of our Bibles Archbishop Usher's unfortunate estimate, 4004 B.C., yet there is perhaps no educated man in this country who is not well aware that the antiquity of the world is to be measured, not by thousands, but by millions of years. Without claiming for ourselves the gift of prophecy, we doubt not that the great antiquity of Man will ere long be as generally recognised.

We speak thus confidently, because, in the first place, we are our-

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individually covered by a thin film (of cellulose ?) explains why they were not previously understood, since this film protects them from the action of dilute hydrochloric acid.

selves satisfied with the evidence; and secondly, because we believe that our countrymen are quite prepared to look fairly into the question, and to adopt any conclusion which the facts may require. They are right, however, in throwing the *onus probandi* on the assertors, and in requiring satisfactory proofs before they accept a discovery which seems to contradict the general tenor of previous investigations. They do, indeed, in this but follow the example which has been set before them. Sir Charles Lyell admits that even among Geologists " extreme reluctance was felt to admit the validity of such evidence," and where Philosophers have hesitated so long, the unscientific public can hardly be expected to follow immediately. This is particularly the case with reference to the cave evidence. We must not be surprised if our countrymen do not at once adopt the conclusions of Dr. Schmerling, when we know that for a quarter of a century his observations were entirely disregarded by Geologists, and that not "even the neighbouring pro- "fessors of the University of Liége came forth to vindicate the truth- "fulness of their indefatigable and clear-sighted countryman." So again, when Dr. Falconer and Mr. Pengelly tell us that in the Brixham Cave, and close to a flint instrument, they found the entire skeleton of the left hind leg of a Cave bear, every bone being present, so that the limb must have been carried into the cave, while the separate bones were still bound together by their natural ligaments; we who know these two gentlemen, who have had many opportunities of testing both their truthfulness, and, what is of equal importance, their accuracy, naturally feel a confidence in their statement, which we cannot expect to be equally shared by the general public.

Since, indeed, Mr. Prestwich dug out the flint implements of M. Boucher de Perthes from the neglect in which they were lying, and established their great antiquity, not only by the Mammalian remains with which they were associated, but by the geological position which they occupied, the proofs of Man's antiquity have multiplied so rapidly, that we are inclined to wonder that Geologists should have hesitated so long, and this is evidently felt by Sir Charles Lyell, who seems to look back almost with astonishment at his own incredulity. And yet, if left to themselves, the Geologists would not perhaps even yet have relinquished their old creed. Fortunately, however, the Zoologist and Philologist were working in the same field, and the three encouraged and assisted one another. As any one of them made a step in advance, he was immediately supported and even driven forward by the other two, and as we shall presently see, though the Geologist is apparently leading the way, the Zoologist is really in advance, and claims for Man a higher antiquity than even Sir Charles Lyell can at present bring himself to admit.

The Saturday Review has truly observed, that the present " work " is a trilogy, the constituent elements of which should be headed " respectively, Prehistoric Man, Ice, and Darwin." On this occasion we shall confine our remarks almost entirely to the first of these subjects. The glacial chapters, indeed, give an excellent resumé of the present state of our knowledge, and strike us as perhaps the most satisfactory portion of the work, but they hardly come within the scope of this Review. As indeed no traces of Man have yet been found in any strata of the glacial period, we might perhaps regard this as an unnecessary digression. Sir Charles, however, brings these facts prominently forward, because " they " enlarge at the same time our conception of the antiquity, not " only of the living species of animals and plants, but of their " present geographical distribution, and throw light on the chronological relations of these species to the earliest date yet ascertained " for the existence of the human race. That date, it will be seen, is " very remote if compared to the times of history and tradition, yet " very modern if contrasted with the length of time during which all " the living testacea, and even many of the mammalia, have inhabited the globe."

The treatise on the Origin of Species is also very ably written, and we were specially struck with the comparison drawn by Sir Charles between the Origin of Species and the Origin of Languages. We are, however, unable to discover that Sir Charles anywhere expresses his own opinion. The strongest passage we have been able to find is the following:—" Yet we ought by no means to undervalue the importance of the step which will have been made, should it ever become " highly probable that the past changes of the organic world have " been brought about by the subordinate agency of such causes as " Variation and Natural Selection." Even the Bishop of Oxford might agree to this sentence, but we can-hardly believe that it expresses Sir Charles Lyell's real opinions, as the whole tenor of his argument is in favour of Mr. Darwin's theory. We will not now, however, enter into this important question, nor will we discuss Sir Charles' views on man's place in nature. They will naturally come before us in our next number, when we shall have to consider Professor Huxley's work on this subject. But with reference to the alleged differences between the human and simian brains, as the historical account of the controversy given by Sir C. Lyell has been attacked, we feel compelled to say, that in our opinion the statements made by Sir Charles are fully in accordance with the facts; and that in this matter he has only expressed the all but universal opinion of scientific anatomists both in this country and abroad.

In the first part of the work Sir Charles brings together the different instances in which remains of men or of human weapons have been found, either associated with bones of extinct animals, or in situations implying great antiquity.

The readers of this Journal will already be prepared for many of the facts and arguments here brought forward. The works of art in the Danish peat-bogs and Kjökkenmoddings; the wonderful Neanderthal skull; the Swiss Lake habitations; the cave of Aurignac; the Geology of the Valley of the Somme; the Archæology of North America—have all been fully treated of in our columns. We may fairly congratulate ourselves on the manner in which this journal is continually referred to by Sir Charles; and though our later numbers have appeared too recently to be mentioned in his work, we rejoice to find that in the most important points we are entirely in unison with him.

We need make no apology to Sir Charles for criticising his work freely. It is, indeed, one of his great merits that when he changes an opinion he tells us so frankly, and even goes out of his way to do it, proving thereby that he values the truth more than his own reputation. Though, therefore, we think that Sir Charles scarcely gives due prominence to the labours of his predecessors in these investigations, and especially to those of Dr. Falconer and Mr. Prestwich, we are quite satisfied that this is unintentional. As might naturally have been expected, it is specially in the biological portions that some few errors have crept in. For instance, he refers the discovery of alternate generation to "Sefström." Who is Sefström? Can it be a misprint for Steenstrup? Again, the focus of the genus Camellia (not Camelia) is in the Indo-Chinese region, so that its selection as a type of the Southern Hemisphere is not happy. So in p. 398 Conifers are excluded from Exogens, while in p. 405 he alludes to them as included in that class. We regret also to see that he adopts Professor Owen's name of *Archæopteryx macrurus* for the Solenhofen enigma. Changes of specific names are highly objectionable, and Professor Owen has not, in the abstract published in the Royal Society's Proceedings, given any reason for rejecting the name proposed by Meyer.

As an illustration of our still very imperfect acquaintance with the entire fauna of the Age of Stone in Denmark, he mentions, p. 371, that, though instruments made of the bones and horns of the Elk and Reindeer have been met with, "yet no skeleton or uncut "bone of either of those species has hitherto been observed in the "same peat;" unless however we are greatly mistaken, remains of both these animals have been found in the peat, and a nearly entire skeleton of the former animal was found in Laaland about the year 1852, and is now in the Museum of Copenhagen. He speaks also of human skulls of the Bronze age found in the Danish peat, but we are not aware that any skulls exist in Denmark which can certainly be referred to that period.

In p. 20, he speaks of amber as having been obtained at Moosseedorf, which is a Swiss lake habitation belonging to the Stone age. This, if it be the case, is important, because it would imply a communication at that early period between the shores of the Baltic and the lakes of Switzerland. But we cannot help thinking that there is some mistake here. It is true that Troyon mentions amber as belonging to the Stone age in Switzerland, on the authority of specimens found at Meilen; but, as a few articles of bronze were also obtained at this locality, we should rather be disposed to refer the amber to the Bronze age.

Sir Charles mentions, with just commendation, the efforts made by the Swiss Archæologists to fix a date for the Lake habitations.

These are three in number—one by M. Morlot, one by M. Gilliéron, and the third by M. Troyon. Of the two former we will say nothing; but the objections to the third are, we think, conclusive, and we would specially call Sir Charles' attention to the memoir by M. Jayet, "Sur la Plaine de l'Orbe," which, however, probably reached him too late to influence his first edition. Sir Charles says that the pile-works at Chamblon, which are concerned in this calculation, belong to the Bronze age, and in this case the result would agree closely with that obtained by MM. Morlot and Gilliéron. M. Troyon, however (Habitations lacustres, p. 73), considers Chamblon as a Stone age station, and we are not aware that any bronze objects have since been found there.

In spite of personal considerations, and notwithstanding the support which they afford to his general argument, Sir Charles finds himself unable to accept the conclusions drawn by Mr. Horner from his researches in Egypt. We are disposed to agree with him in this, but we are influenced by different considerations, and the objection which appears to him fatal to Mr. Horner's argument, seems to us, on the contrary, to be fallacious.

"The point sought to be determined was the exact amount of "Nile mud which has accumulated in 3000 or more years, since the "time when certain ancient monuments, such as the obelisk at "Heliopolis, or the statue of King Rameses at Memphis, are supposed by some antiquaries to have been erected."

Sir Charles admits that the researches were judiciously and carefully made, and he disposes of several objections which have been urged against them; but then, he adds, "the ancient Egyptians are "known to have been in the habit of enclosing with embankments "the areas on which they erected temples, statues, and obelisks, so as "to exclude the waters of the Nile." . . . .

And further, "Even if we knew the date of the abandonment of "such embankments," it is argued that the enclosed areas would not afford the means of "ascertaining the average rate of deposit in the "alluvial plain." For, when the waters at length broke into such depressions, they would, "at first, carry with them into the enclosure "much mud washed from the steep surrounding banks, so that a "greater quantity would be deposited in a few years than perhaps in "as many centuries on the great plain outside the depressed area."

But this would only bring the depression up to the general level of the plain; the "disturbing causes" would then altogether cease, and the general elevation would therefore still be a measure of the rate of deposition; so that, ingenious as Sir Charles Lyell's argument at first appears, it does not, in our opinion, affect the value of Mr. Horner's conclusion.

Let us now endeavour to ascertain what is the antiquity which Sir Charles ascribes to the human race. He nowhere, indeed, gives us his opinion in so many words, but, to arrive at it, we must collate passages from several parts of the work. In his "Travels in North America," he has shown that the delta and alluvial plain of the Missisippi consist of sedimentary matter, and after ascertaining the annual discharge of water and the mean amount of solid matter contained in it, he estimated that the river would require 100,000 years to bring down so large a quantity of solid matter, a period which, large as it seems, he still regards as the lowest estimate of the time required. Now it is stated that, in the loam forming the bluff on one side of the valley, and therefore older *even than its excavation,* the pelvic bone of a man is said to have been found near Natchez.

Sir Charles, indeed, prudently suspends his judgment as to the high antiquity of this fossil; but, he adds, "if I am asked whether I " consider the Natchez loam, with land shells and the bones of Mas- " todon and Megalonyx, to be more ancient than the alluvium of the " Somme, containing flint implements and the remains of the mam- " moth and hyæna, I must declare that I do not." Consequently in his opinion, the drift hatchets of England and France are at least 100,000 years old.

But we must prepare ourselves for even more startling numbers than these.

As the simplest "series of changes in physical geography which can possibly account for the phenomena of the glacial period," Sir Charles gives the following:—

"First, a continental period, towards the close of which the " forest of Cromer flourished: when the land was at least 500 feet " above its present level, perhaps much higher, and its extent pro- " bably greater than that given in the map, fig. 41." In which the British Isles, including the Hebrides, Orkneys, and Shetlands, are connected with one another and with the Continent, the whole German Ocean being laid dry.

"Secondly, a period of submergence, by which the land north of " the Thames and Bristol Channel, and that of Ireland, was gradually " reduced to such an archipelago as is pictured in map, fig. 40; and " finally to such a general prevalence of sea as is seen in map, fig. " 39." (In which only the tops of the mountains are left above water). "This was the period of great submergence and of floating " ice, when the Scandinavian flora, which overspread the lower " grounds during the first continental period, may have obtained " exclusive possession of the only lands not covered with perpetual " snow."

"Thirdly, a second continental period, when the bed of the glacial " sea, with its marine shells and erratic blocks, was laid dry, and " when the quantity of land equalled that of the first period."

It is evident that such great changes would require a great lapse of time. Sir Charles assumes a mean rate of 2½ feet in a century. We must confess that we should have liked to see this point more satisfactorily established. However, as Sir Charles himself says with reference to the calculations made by the Swiss Archæologists, it "deserves notice and appears to us to be full of promise." At any rate, as Bacon has well said, "Citius venit veritas ex errore quam ex confusione."

On this hypothesis, the submergence of Wales to the extent of 1,400 feet, would, at this rate, require 56,000 years, "but taking "Prof. Ramsay's estimate of 800 feet more, that elevation being "required for the deposition of some of the stratified drift, we must "demand an additional period of 32,000 years, amounting in all to "88,000; and the same time would be required for the re-elevation "of the tract to its present height. But if the land rose in the second "continental period no more than 600 feet above the present level, "this . . . . would have taken another 26,000 years; the whole of "the grand oscillation, comprising the submergence and re-emergence, "having taken, in round numbers, 180,000 years for its completion; "and this, even if there were no pause or stationary period, when "the downward movement ceased, and before it was converted into "an upward one." Here some misprint has probably crept in; 600 feet, at the rate assumed by Sir Charles, would give 24,000, and not 26,000 years, and allowing for the final return to our present level, the sum of the periods, viz. 88,000+88,000+24,000+24,000, would give, not 180,000 but 224,000 years. But as we are endeavouring to arrive at Sir Charles Lyell's own opinion, we must take his estimate. This period of 188,000 years, enormous as it is, comprehends, however, the post pliocene age only, and says Sir Charles we "may anticipate the finding of his remains on some future day in the Pliocene period;" and thus, leaving this latter as an unknown quantity, the antiquity of man is 188,000 years$+x$, the unknown element being in all probability the greater of the two.

Here however at length he stops. "We cannot," he says, "expect to meet with human bones in the Miocene formations, where "all the species and nearly all the genera of mammalia belong to "types widely differing from those now living."

But if Man constitutes a separate family of the Primates—and, still more so, if he represents a special order—then, according to all analogy, there must have been some representatives of the family in Miocene times. Sir Charles, indeed, says that had any "other "rational being, representing man, then flourished, some signs of his "existence could hardly have escaped unnoticed, in the shape of "implements of stone or metal, more frequent and more durable "than the osseous remains of any of the mammalia."

How far our ancestors in Miocene times were rational beings we are not prepared to say; but we are astonished to find Sir Charles Lyell relying on negative evidence in Palæontology. No Geologist has hitherto more ably maintained the Imperfection of the Geological Record, and even out of the present volume we might quote Sir Charles against himself. We will content ourselves with holding up the Amiens hatchets as a warning, and will only observe that, whatever the negative evidence may be worth, it applies to Pliocene as well as to Miocene times.

Moreover if the Engis skull really belongs to the period of the extinct mammalia, and yet agrees with many a European skull of the present day, then, as Professor Huxley well observes, "the "first traces of the primordial stock whence man has proceeded need "no longer be sought by those who entertain any form of the doc-"trine of progressive development in the newest tertiaries, but that "they may be looked for in an epoch more distant from the age of "the Elephas primigenius than that is from us."

If, during the immense period which has elapsed since the Engis man lived in company with the Mammoth, the Cave Bear, the Cave Hyæna, the woolly-haired Rhinoceros, and other extinct mammalia, so slight a change has occurred in the form of the human cranium, how long must it have taken to bridge over the great gulf between the genus Homo and his nearest relatives among the Apes. Misled by early education, trusting too much to the negative evidence afforded by the absence of human remains in tertiary strata, Geologists have hitherto adopted the hypothesis of separate creations; and the appearance of new species is perhaps the only case remaining in which men of science are still satisfied to accept miraculous interference as a satisfactory explanation of a scientific fact. In some respects the position of the question resembles the phenomenon presented to Astronomers by the perturbations of Uranus. They might have accounted for these perturbations by the hypothesis of miracles; they might have argued that no trace of an exterior planet had ever been discovered. But they knew better the value of negative evidence in science; they trusted more fully in the universality of law, and their faith was rewarded by the discovery of Neptune.

Or, again, let us take the problem presented to us by the Sun. It is difficult to understand how light and heat can have been emitted for so long a period as that demanded by Geologists. Lately, indeed, a theory has been suggested in explanation by Dr. Mayer of Heilbronn and by Mr. Waterston; it is supported by several eminent physicists, as, for instance, Professor Tyndall and Professor W. Thomson, but it cannot be said to be generally adopted. Still, no astronomer, so far as we are aware, has ever proposed in a scientific treatise to account for the phenomenon by miraculous interference; and it is remarkable that a hypothesis for which there is not a vestige of evidence, which is indeed opposed to the whole tenor of scientific research, and which has been universally rejected in every other case, should have been almost as universally adopted in explanation of the successive Origin of Species.

Without, then, expressing any decided opinion as to the age of Man, estimated in years, we feel compelled to demand for him a greater geological antiquity than Sir Charles Lyell is prepared to admit. It is immaterial, in this respect, whether we adopt the theory of Natural Selection which we owe to the genius of Darwin; any other form of the doctrine of transmutation would force us to the same conclusion. But the eloquent words in which Tyndall* refers to Mayer, may, in our opinion, be equally applied to our illustrious countryman. "He deals with true causes: and the only question "that can affect his theory refers to the quantity of action "which he has ascribed to these causes. I do not pledge myself to "this theory, nor do I ask you to accept it as demonstrated: still, it "would be a great mistake to regard it as chimerical. It is a noble "speculation; and, depend upon it, the true theory, if this or some "form of it be not the true one, will not appear less wild or less "astounding."

Though the opinions of Sir Charles Lyell concerning the Antiquity of Man may not be generally adopted, we might at least expect them to be known by all those who undertake to write upon the present state of Science. It is surprising, therefore, that Dr. Cumming, ("Moses Right and Bishop Colenso Wrong," Part 7, page 138), should, so lately as last month, have cited Sir Charles Lyell as an authority for the recent appearance of Man upon the earth. The Doctor is, however, not very particular in his use of authorities. Thus (p. 33) he quotes Buckland's "Reliquiæ Diluvianæ" as Geological evidence in favour of a universal deluge; and, in p. 50, he parodies Scripture as follows:—"If Bishop Colenso had "believed Buckland, and Professor Sedgwick, and Professor Hitchcock, he would "have believed in Moses; but as he does not believe in their evidence, how can he "believe in what Moses records?" Buckland, however, long ago abandoned the views advocated in the above-mentioned work, Sedgwick will be surprised to find himself quoted as believing that there are any geological evidences of a universal deluge, and not only does Professor Hitchcock agree with Bishop Colenso as to the non-universality of the deluge, but Dr. Cumming knew this at the time he wrote; for, in the very next page, he says "Professor Hitchcock, from whom "I have largely quoted,—a thoroughly Christian man,—also believes that the "flood was not universal."

As ignorant apparently of Latin as of Geology, Dr. Cumming regards the grooves and furrows, or, as he calls them, "the *scoriæ*,"—the italics are not ours—"upon the stones at Brora, for instance, in Sutherlandshire, and in other parts "of the kingdom" (p. 48), as evidences of the Mosaic Deluge!

XVII.—CONTRIBUTIONS TO AN INSECT FAUNA OF THE AMAZON VALLEY. By Henry Walter Bates, Esq. Transact. Linnean Soc. Vol. XXIII. 1862, p. 495.

THE author reveals some curious facts in this memoir, which from its unpretending and somewhat indefinite title we fear may be overlooked in the ever-flowing rush of scientific literature. The main subject discussed is the extraordinary mimetic resemblance which certain butterflies present to other butterflies belonging to distinct groups. To appreciate the degree of dissimulation practised by these insects, it is necessary to study the beautiful plates with which the memoir is adorned. In a district where, for instance, an *Ithomia* abounds in gaudy swarms, another butterfly, namely a *Leptalis*, will often be found mingled in the same flock, so like the *Ithomia* in every shade and stripe of colour and even in the shape of its wings, that Mr. Bates, with his eyes sharpened by collecting during eleven years, was, "though always on my guard," continually deceived. When the mockers and the mocked are caught and compared they are found to be totally different in essential structure, and to belong not only to distinct genera, but often to distinct families. If this mimicry had occurred in only one or two instances, it might have been passed over as a strange coincidence. But travel a hundred miles, more or less, from a district where one *Leptalis* imitates one *Ithomia*, and a distinct mocker and mocked, equally close in their resemblance, will be found. Coloured drawings of seven mocking forms of *Leptalis*, and six mocked forms of *Ithomia*, and one of another genus are given. Altogether no less than ten genera are enumerated, which include species that imitate other butterflies. The mockers and mocked always inhabit the same region; we never find an imitator living remote from the form which it counterfeits. The mockers are almost invariably rare insects; the mocked in almost every case abound in swarms. In the same district in which a species of *Leptalis* closely imitates an *Ithomia*, there are sometimes other Lepidoptera mimicking the same *Ithomia;* so that in the same place, species of three genera may be found all closely resembling a species of a fourth genus. It is highly remarkable that even moths, notwithstanding their dissimilarity in structure and general habits of life, sometimes so closely imitate butterflies (these butterflies being simultaneously mocked by others) that, as Mr. Bates says, when "seen on the wing in their native woods, they deceive the most experienced eye." These several facts and relations carry the strongest conviction to the mind that there must be some intimate bond between the mocking and mocked butterflies. It may, however, be naturally asked, why is the one considered as the mocked form; and why are the others, or two or three other butterflies which inhabit the same district in scanty numbers, considered as the mockers? Mr. Bates satisfactorily answers this question, by showing that the form which is imitated keeps the usual dress of the group to which it belongs, whilst the counterfeiters have changed their dress and do not resemble their nearest allies.

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* Heat considered as a mode of motion, p. 426.

In these facts, of which only a brief abstract has been given, we have the most striking case ever recorded of what naturalists call analogical resemblance. By this term naturalists mean the resemblance in shape, for instance, of a whale to a fish—of certain snake-like Batrachians to true snakes—of the little burrowing and social pachydermatous *Hyrax* to the rabbit, and other such cases. We can understand resemblances, such as these, by the adaptation of different animals to similar habits of life. But it is scarcely possible to extend this view to the variously coloured stripes and spots on butterflies; more especially as these are known often to differ greatly in the two sexes. Why then, we are naturally eager to know, has one butterfly or moth so often assumed the dress of another quite distinct form; why to the perplexity of naturalists has Nature condescended to the tricks of the stage? We remember only one statement, made by Mr. Andrew Murray in his excellent paper on the Disguises of Nature, namely that insects thus imitating each other usually inhabit the same country, which combined with the fact of the imitators being rare and the imitated common, might have given a clue to the problem. Mr. Bates has given to these facts the requisite touch of genius, and has, we cannot doubt, hit on the final cause of all this mimicry. The mocked and common forms must habitually escape, to a large extent, destruction, otherwise they could not exist in such swarms; and Mr. Bates never saw them preyed on by birds and certain large insects which attack other butterflies; he suspects that this immunity is owing to a peculiar and offensive odour that they emit. The mocking forms, on the other hand, which inhabit the same district, are comparatively rare, and belong to rare groups; hence they must suffer habitually from some danger, for from the number of eggs laid by all butterflies, without doubt they would, if not persecuted, in three or four generations swarm over the whole country. Now if a member of one of these persecuted and rare groups were to assume a dress so like that of a well-protected species that it continually deceived the practised eyes of an ardent entomologist, it would often deceive predacious birds and insects, and thus escape entire annihilation. This we fully believe is the true explanation of all this mockery.

Mr. Bates truly observes, that the cases of one butterfly mocking another living butterfly do not essentially differ from the innumerable instances of insects imitating the bark of trees, lichens, sticks, and green leaves. Even with mammals, the hare on her form can hardly be distinguished from the surrounding withered herbage. But no case is known of a deer or antelope so like a tiger as to deceive a hunter; yet we hear from Mr. Bates of insects more dissimilar than a ruminant and carnivore, namely, of a cricket most closely resembling a *cicindela*—a veritable tiger amongst insects. Amongst birds, all that habitually squat on the ground in open and unprotected districts, resemble the ground, and never have gaudy plumage. It appears, however, that two cases of birds mocking other birds have been observed by that philosophical naturalist, Mr. Wallace. Amongst insects, on the other hand, in all parts of the world, there are innumerable cases of imitation; Mr. Waterhouse has noted an excellent instance (and we have seen the specimens) of a rare beetle inhabiting the Philippine Archipelago, which most closely imitates a very common kind belonging to a quite distinct group. The much greater frequency of mockery with insects than with other animals, is probably the consequence of their small size; insects cannot defend themselves, excepting indeed the kinds that sting, and we have never heard of an instance of these mocking other insects, though they are mocked: insects cannot escape by flight from the larger animals; hence they are reduced, like most weak creatures, to trickery and dissimulation.

By what means, it may be asked, have so many butterflies of the Amazonian region acquired their deceptive dress? Most naturalists will answer that they were thus clothed from the hour of their creation—an answer which will generally be so far triumphant that it can be met only by long-drawn arguments; but it is made at the expence of putting an effectual bar to all further inquiry. In this particular case, moreover, the creationist will meet with special difficulties; for many of the mimicking forms of *Leptalis* can be shown by a graduated series to be merely varieties of one species; other mimickers are undoubtedly distinct species or even distinct genera. So again, some of the mimicked forms can be shown to be merely varieties; but the greater number must be ranked as distinct species. Hence the creationist will have to admit that some of these forms have become imitators, by means of the laws of variation, whilst others he must look at as separately created under their present guise; he will further have to admit that some have been created in imitation of forms not themselves created as we now see them, but due to the laws of variation! Prof. Agassiz, indeed, would think nothing of this difficulty; for he believes that not only each species and each variety, but that groups of individuals, though identically the same, when inhabiting distinct countries, have been all separately created in due proportional numbers to the wants of each land. Not many naturalists will be content thus to believe that varieties and individuals have been turned out all ready made, almost as a manufacturer turns out toys according to the temporary demand of the market.

There are some naturalists, who, giving up to a greater or less extent the belief of the immutability of species, will say that as the mocked and mocking forms inhabit the same district, they must have been exposed to the same physical conditions, and owe to this circumstance their common dress. What direct effect the physical conditions of life, that is, climate with all its contingencies and the nature of the food, produce on organic beings is one of the most abstruse problems in natural history, and cannot be here discussed. But we may remark that when a moth closely resembles a butterfly, or better still, when a cricket resembles a *Cicindela*, it becomes very difficult to believe that insects so widely dissimilar in their internal structure and habits of life, should have had their external organization alone so largely influenced by their conditions of life as to become almost identical in appearance. Can we believe that one insect comes to resemble the bark of a tree; another a green leaf; another in its larval condition the dead twig of a branch; or that a quail or snipe comes to resemble the bare ground on which it lies concealed, through the direct action of the physical conditions of life? If in these cases, we reject this conclusion, we ought to reject it in the case of the insects which mock other insects.

Assuredly something further is required to satisfy our minds: what this something is, Mr. Bates explains with singular clearness and force. He shows that some of the forms of *Leptalis*, whether these be ranked as species or varieties, which mimick so many other butterflies, vary much. In one district several varieties (which are figured) occur; one alone of these pretty closely resembles the common *Ithomia* of the same district. In a few other cases, this *Leptalis* presents two or three varieties, one of which is much commoner than the others, and this alone mocks an *Ithomia*. In several cases a single *Leptalis*, which sometines must be ranked, according to the usual rules followed by naturalists, as a variety and sometimes as a distinct species, mocks the common *Ithomia* of the district. From such facts as these, Mr. Bates concludes that in every case the *Leptalis* originally varied; and that when a variety arose which happened to resemble any common butterfly inhabiting the same district (whether or no that butterfly be a variety or a so-called distinct species) then that this one variety of the *Leptalis* had from its resemblance to a flourishing and little persecuted kind a better chance of escaping destruction from predacious birds and insects, and was consequently oftener preserved;—"the less perfect degrees of resemblance being generation after generation eliminated, and only the others left to propagate their kind." This is Natural Selection. Mr. Bates extends this view, supporting it by many facts and forcible arguments, to all the many wonderful cases of mimickry described by him. He adds, "thus, although we are unable to watch the process of formation of a new race as it occurs in time, we can see it, as it were, at one glance, by tracing the changes a species is simultaneously undergoing in different parts of the area of its distribution."

To the naturalist who is interested with respect to the origin of species, the most important parts of this Memoir, together with the descriptive portion at the end, are probably those which treat on the limits of species, on sexual variation, on the variation of important characters, such as the neuration of the wings, &c. We cannot here discuss these points. Mr. Bates shows that there is a perfect gradation in variability, from butterflies, of which hardly two can be found alike, to slight varieties, to well-marked races, to races which can hardly be distinguished from species, to true and good species. Under this point of view, the history of *Mechanitis polymnia* well deserves study: after describing its several varieties, Mr. Bates adds, "these facts seem to teach us that, in this and similar cases, a new species originates in a local variety, formed in a certain area, where the conditions are more favourable to it than to the typical form, and that a large number of such are simultaneously in process of formation from one variable and widely distributed species." It is hardly an exaggeration to say, that whilst reading and reflecting on the various facts given in this Memoir, we feel to be as near witnesses, as we can ever hope to be, of the creation of a new species on this earth.

We will only notice briefly one other point which has an important bearing on the production of new races and species; namely the statement repeatedly made that in certain cases the individuals of the same variety evince a strong predilection to pair together. We do not wish to dispute this statement; it has been affirmed by credible authors, that two herds of differently coloured deer long preserved themselves distinct in the New Forest; and analogous statements have been made with respect to races of sheep in certain Scotch islands; and we know no reason why the same may not hold good with varieties in a state of nature. But we are by our profession as critics bound to be sceptical, and we think that Mr. Bates ought to have given far more copious evidence. He ought also to have given in every case his reasons in full for believing that the closely allied and co-existing forms, with which his varieties do *not* pair, are not distinct species. Naturalists should always bear in mind such cases as those of our own willow wrens, two of which are so closely alike that experienced ornithologists can with difficulty distinguish them, excepting by the materials of which their nests are built; yet these are certainly as distinct species as any in the world.

We think so highly of the powers of observation and reasoning shown in this Memoir, that we rejoice to see by the advertisements that Mr. Bates will soon publish an account of his adventures and his observations in natural history, during his long sojourn in the magnificent valley of the Amazon. We believe that this work will be full of interest to every admirer of Nature.

XVIII.—PRODROMUS MONOGRAPHIAE SCITAMINEARUM, ADDITIS NONNULLIS DE PHYTOGRAPHIA, DE MONOCOTYLEIS ET ORCHIDEIS. Auctore P. Horaninow. Petropoli. 1862.

THE Family of Scitamineæ has never attracted so much of the attention of cultivators as have the Orchids, so that our stores do not contain such ample means of studying its species as are afforded in the case of the latter Family. Unfortunately, too, (as is also the case with Orchids), the species of this Order dry badly, the foliage affords but little aid in discriminating species, and the flowers are, generally, extremely delicate in texture, and so much compressed in the process of drying, that it is most difficult to get a satisfactory knowledge of the shape and structure of the corolla and anthers.

The position of our author is not at all favourable for the preparation of an exhaustive monograph of a family which cannot be studied to advantage in the Herbarium, so that we have no right to look to him for that great desideratum. This work will, however, be very useful as a carefully compiled *resumé* of the species of the Order, and it will be of great use to any botanist who may be able to undertake, under more favourable conditions, a critical examination of the species. The flowers (like those of Orchids) vary very much, and the study of the species in their native habitats, and cultivated side by side in the open air, will probably result in very considerable reduction in their number.

Hr. Horaninow has not made many additions to the received genera of Scitamineæ, and of those which he has added, *Nicolaia* had been indicated by Bojer, Hooker, and Lindley; and *Dymczewyczia* is a well-marked section of *Zingiber*, characterised by terminal inflorescence. *Geocallis* is only known from a drawing, so that it is premature to make a genus of it; and *Achirida* is the well-known *Canna iridiflora.* His only other new genus, *Ensete,* does not seem sufficiently distinct from *Musa.* The genera are grouped under 4 cohorts, viz. Marantaceae, Cannaceae (C. Koch), Amomaceae, and Musaceae.

It is to be regretted that our author should have introduced into his descriptions a number of new terms not in the least better than those which they are intended to replace, as they make the generic characters quite unintelligible without previous study. The use of the term *parapetala* for the petal-like barren filaments of the outer staminal verticil, may perhaps be found convenient, but *hypanthium** for inferior ovary, and *amalthaea* for the fruit which results from it, are terms which do not appear to offer any advantage over those in ordinary use, and are therefore not likely to be adopted. Still less justifiable, if not indeed positively reprehensible, is the transfer of the term *rhizoma,* which is in common use to designate that peculiar underground form of the 'ascending axis' which has a *prima facie* resemblance to the root, and was formerly confounded with it, to the true root. In a preliminary dissertation on terminology, our author has entered into details on these definitions, and has suggested various other modifications of the received terminology, all of which he considers important, but which seem to us to be sometimes, as in the above instance, really injurious, or for the most part useless. As one instance, we may cite the proposed change of the term *labellum,* as applied to the posterior petal of Orchids to *labrum,* because it is not smaller but larger than the other petals. For others we may refer such of our readers as may be desirous of pursuing the subject to the work itself.

In the preliminary remarks which introduce the main subject of the work, Hr. Horaninow adverts briefly to many interesting points of botanical classification, chiefly relating to Endogens. He finds great fault with the names Monocotyledon and Dicotyledon, and proposes to substitute for them the words *Coccospermae* and *Euspermae.* These terms we quote for the benefit of such of our readers as feel scruples of conscience at the employment of terms so incorrect as those in common use. Our author's emendations, are, however, not confined to nomenclature, as he proposes to transfer from

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* This term is applied by Berg to the free portion of the calyx-tube in Myrtaceae and allied Families.

Euspermae to *Coccospermae* not only Nymphaeaceae (the position of which is perhaps still an open question) but Piperaceae, Chlorantheae, and Ceratophyllum. When these have been added to Endogens, the whole constitute his class Coccospermae, which he divides into *Coleophyta* and *Liriophyta*, the former including Grasses, Cyperaceae, Palms, Commelynaceae, Juncaceae, Alismaceae, Ruppiaceae, Triurideae, and Hydrocharideae; and the latter Liliaceae, in the widest sense, Orchids, Scitamineae, Taccaceae, Araceae, and Piperaceae, with the other Exogens named above. M. Horaninow's remarks on these and other points of classification are very general, but he promises at a future period further details and explanations.

In further illustration of the readiness with which M. Horaninow changes names, it deserves mention that his proposed Suborders of Orchids differ from those of Lindley only in name, except in the case of Cypripedieae, where there are difficulties in the way of such a change.

XIX.—AUFZAEHLUNG DER VON RADDE IN BAIKALIEN, DAHURIEN UND AM AMUR SOWIE DER VON HERRN V. STUBENDORFF UND ANDEREN GESAMMELTEN PFLANZEN. Bearbeitet von E. Regel. Vol. I. Moskau, 1861-2.

UEBERSICHT DER ARTEN DER GATTUNG *Thalictrum* WELCHE IM RUSSISCHEN REICHE UND DEN ANGRAENZENDEN LAENDERN WACHSEN. Von E. Regel. Moskau, 1861.

FLORA USSURIENSIS. St. Petersburg, 1862. By E. Regel.

WE cannot permit the receipt of a second part of the first-named important work of Dr. Regel's to pass, with only the brief recognition accorded in our Annual Bibliography. It appears to us to deserve the careful notice of botanists, especially of our British botanists, on several grounds; chiefly because the author's mode of treatment corresponds very closely with that which we have in previous notices spoken of as of a kind we would fain our own monographers and writers of Floras endeavoured more closely to follow, and also because the general character of the vegetation concerned has much in common with that of our own islands.

In a short introduction of six pages the plan of the work is explained, and an account given of the collections which furnish the material for this 'Aufzählung.' The plants gathered by Hr. G. Radde in the Baikal, Dahuria, and Amurland, were transferred to the Herbarium of the Imperial Botanic Gardens at St. Petersburgh, through the offices of the Baron von Meyendorff. Dr. Regel, the superintendent of this establishment, in undertaking their elaboration, found it desirable to incorporate with them, in one common enumeration, other rich accumulated material derived from the same, or conterminous tracts of the great Northern Empire. The plants acquired by Governor Stubendorff in Siberia, and on his Kamtschatka journey of 1849, form one of the most important of these accessory collections.

With material so abundant, and the advantage of constant access to the original specimens contained in the St. Petersburgh Herbarium, which is extremely rich in northern plants, our author found himself in a position to revise several of the more difficult genera and subgenera, and one valuable result of his comparisons, we find in many synoptical monographs scattered through the work in the form of notes. Some of the more important of these groups Dr. Regel proposes to publish independently, as in the case of the genus *Thalictrum*, issued last year. The elaboration of the Monopetalous Orders is assigned to v. Herder, known to us as joint author with Regel and Rach of an Enumeration of the plants collected by Paullowsky and Stubendorff in Siberia. All the remaining Orders, both Phanerogamic and Cryptogamic, Dr. Regel undertakes. Herr Radde himself proposes to work up a general review of the relations of the vegetation of the tracts which he travelled over, noting the distribution, &c., of the more characteristic species.

Dr. Regel expresses his deep conviction of the importance of the claim which scientific botany now makes on the systematist, that the innumerable forms and varieties which have been set up as species, should be reduced and referred to the respective specific types from which, through the influence of various external agents, they have more or less departed. It appears to have been his honest endeavour to act in accordance with this view, so far as his work has progressed, and upon the whole, as it seems to us, he has been fairly successful in applying it. This, however, experience will best show, for the real advantage which we conceive to arise from the employment of a comprehensive specific term, though it must be greatly dependent upon a correct appreciation on the part of the monographer of such influence in modifying his specific types, depends also in no small degree upon a nicety of judgment and capability of balancing the comparative value of what we call *characters*, and of estimating affinities, which are by no means at the command of many even of our best botanists. One or two examples which we shall presently select, will serve to show Dr. Regel's method better than our farther explanation.

In the enumeration, which now extends to Caryophyllaceae, no diagnoses or descriptions are given excepting of new species and varieties, and when additions to or corrections of previous writings are called for. In the synoptical reviews of genera referred to above, and which are not incorporated in the enumeration, brief diagnostic characters are however given. The works of Ledebour, Middendorf, Trautvetter, Ruprecht,* Hooker, Gray, Bunge, and other writers, upon the Russian and kindred Floras, are quoted throughout. The locality, time of flowering, and name of the collectors follow these.

One grave fault forces itself upon us as we cut the pages of this book, affecting however the printer rather than the author. The notes, as we have observed, are very extended, often occupying several successive pages save a line or two at the top of each. It would have been better had they been collected and separately paged at the end of each published part, or if not separated in this way they should at any rate have been printed in a type more obviously different from that of the enumeration, and a line should have crossed each page where the notes begin. It is true there is a difference in the type and there is a slender black line, but the type is only slightly different and the line not half an inch in length. We are always impatient of petty inconveniences of this kind which a little attention might have spared us. It is regrettable the more in this case seeing the book is likely to extend to several volumes. While on this subject we would suggest that the names of the Natural Orders heading their respective lists of species might have been in more conspicuous characters, and a running title of each Order or genus might have been used with advantage. Much space, moreover, ought to have been saved by a better arrangement of the matter.

The genera, subgenera, &c., of which synopses of the species are given, are the following: in most cases Russian species only are included; in some, only E. Siberian.

Thalictrum (published separately), *Pulsatilla, Adonis* §*Consoligo, Trollius, Aconitum, Draba* §*Chrysodraba, Viola, Parnassia, Polygala, Silene* §*Atocion and* §*Otites, Silena graminifolia* (*conspectus varietatum*), *Lychnis* §*Gasterolychnis, L. apetala* (*consp. varietatum*), *Alsineae* (*consp. generum*), *Alsine, Arenaria, Stellaria, Cerastium, C. alpinum* (*consp. varietatum lusuumque*).

We proceed to notice a few of the genera, selecting such as are of interest to British botanists.

Thalictrum. Of this peculiarly difficult genus nineteen species are included in the separately published 'Uebersicht.' Of these Dr. Regel admits that probably several can hardly be maintained as species, and that they are retained for the present in deference to generally accepted views regarding them. The primary test in the analysis of the species is derived from the fruit. They are arranged under the sections, A. *carpella stipite manifesto suffulta;* B. *carpella stipite brevi suffulta;* and C. *carpella sessilia.*

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* A just tribute is recorded in the Introduction to the merit of a work of importance, but a single volume of which has as yet reached us, the 'Flora Ingrica' of Dr. Ruprecht. We wholly concur in Dr. Regel's opinion, that this excellent botanist errs in judgment in not accepting the priority of the Linnean nomenclature, a mistake which we conceive must materially and very properly interfere with the usefulness of his book.

The secondary groups hinge upon the form of the filament, which in many species is more or less dilated above, in others filiform.

The larger proportion (12 species) belong to the subsection characterised by 'carpella sessilia' and 'filamenta filiformia.' It includes some of the most variable species, as *T. minus*, *T. elatum*, *T. fœtidum*, *T. majus*, *T. simplex*, *T. flavum*, &c.

By far the most stable form amongst these northern Thalictrums, with a wide area of distribution, appears to be the little alpine Thalictrum (T. *alpinum*); a species extending from Canada and Greenland through Siberia and Europe to our own islands, where it occurs in mountain moorlands from the Shetlands to North Wales. We find it again in the Alps and Caucasus, and it reappears in the Himalaya, where, consequently, it has been described as a new species by Dr. Royle, though in no way differing from the home plant. As, however, this species is subject to but slight variation it is honourably distinguished amongst its congeners by a comparative absence of the synonyms and segregates which betoken a 'plastic' nature.

Thalictrum minus is in remarkable contrast with this species. Under various forms common in Britain, both on the coast and in subalpine and rocky districts, it extends eastward through Europe, Siberia, and Central Asia. It is absent from America, as are also our remaining species *T. majus* and *T. flavum*. In respect to *T. minus*, Regel says of the numerous forms which have been elevated to specific rank, that they pass so insensibly into one another that it is impossible to maintain them independently as species. The surface, form and colour of the leaves, the form of the auricles of the sheathing leaf-base, and character of the inflorescence, are not constant, and whoever examines a rich series of specimens of this group must become convinced that all these characters vary with soil, climate and amount of exposure. The form of the stigma is the special character in which Dr. Regel confides as distinguishing this species from its allies, *T. majus* and *T. elatum*. It is described as oblong, broadest at the base, and obliquely adnate to the top of the carpel. In *T. majus* the stigma is flat, oval or circular, or even broader than long, with a cordate base; it afterwards becomes twisted so as to appear as though linear in the ripe fruit.

The European forms of *T. minus*, are—

α. Jacquini. (*T. collinum*, Rchb., *T. montanum*, Wallr. et *T. montanum*, *β. roridum*, Wallr., *T. minus*, Gr. et Godr.)

β. procerum.—(*T. minus*, E. Bot., *T. saxatile*, Schl., *T. sylvaticum*, Koch.)

γ. nutans.—(*T. nutans*, Desf.)

δ. virens, Koch.—(*T. majus*, E. Bot., *T. montanum*, Wallr. *α. virens*, *T. collinum*, Wallr., *T. flavo-virens*, Ledb., *T. sibiricum*, DC., *T. saxatile*, Schleich., Gr. et Godr., *T. flexuosum*, Bernh., *T. Schweiggeri*, Sprg.)

ε. *appendiculatum.*—(*T. collinum*, Ledb., *T. appendiculatum*, C. A. M., *T. squarrosum*, Steph., *T. Jacquinianum*, Koch.)

ζ. *puberulum.*

η. *glandulosum*, Koch.—(*T. pubescens*, Schl.)

Thalictrum Kemense of Fries is held specifically distinct.

Viola. We quite agree with Dr. Regel in his treatment of *V. canina*, L. The forms of this species include, amongst others unfamiliar to English readers, *V. sylvestris*, Lam., *V. sylvatica*, Fries, *V. Ruppii*, All., *V. Riviniana*, Rchb., *V. flavicornis*, Sm., *V. arenaria*, DC., *V. Muhlenbergiana*, Ging., *V. Allionii*, Pio, and their subordinates. *V. montana*, L. is maintained as specifically distinct. From the diagnosis of the species by Linnæus, it might be supposed he had in view a form of *V. canina* with longer leaves, but his reference to a figure of Morison's convinces Regel this was not entirely the case. *V. stagnina*, Kit. (*V. lactea* et *stagnina*, Rchb.) is the var. γ of *V. montana.*

Alsineae. Dr. Regel's '*conspectus generum*' of this section of Caryophylleae, offers some features at variance with the distribution of genera recently proposed by Messrs. Bentham and Hooker in their 'Genera Plantarum.' *Honkenya*, *Adenonema*, *Mœhringia*, *Merckia*, *Malachium*, and *Krascheninnikowia* are maintained. *Buffonia* is merged in *Adenonema*, which latter Messrs. B. and H. sink in *Stellaria*, though Regel separates it in his synopsis—*Adenonema* with the valves of the capsule equalling the styles in number, while in *Stellaria* they are twice as many. Dimorphic flowers do not constitute an essential character of *Krascheninnikowia*, which is here described as differing from *Stellaria* in its glochidiate seeds.

Arenaria verna and its numerous varieties proffer an interesting study which must not detain us. Its var. *Gerardi* of the Lizard hills occurs in the Altai and mountains of Baikal. *Arenaria rubella* is regarded as a subvariety (lusus) of the same plant. This may probably be correct. It has but little claim to specific distinction.

Cerastium viscosum, L. (*C. glomeratum*, Thuill), *C. semidecandrum*, L. and *C. vulgatum*, L. (*C. triviale*, Lk.) are maintained.

We shall look for further issues of Dr. Regel's 'Aufzählung' with some interest.

The 'Flora Ussuriensis' is based upon specimens collected by Maack in the region of the Ussuri, a tributary of the Amur. No new genera, but several new species are described. The descriptions are in Latin, the extended observations in Russ. A Table is appended showing the number of known species on the (1) Ussuri, (2) Amur, (3) in N. E. Asia, and (4) in Japan; also the number of Ussuri species common to the Amur, N. E. Asia, Japan, and North America. Separate lists are given of the species of the Ussuri not enumerated in 'Flora Amurensis,' the species common to Japan, to N. E. Siberia and Kamtschatka and to N. America.

XX.—DIE FARBEN DER PFLANZEN. Von G. von Martens. Württ. Jahreshefte, 1862, p. 239.

THE first short chapter of this essay on Colour in the Vegetable Kingdom is upon the Rainbow, and is headed with a verse from Sirach (ch. xliii. 12). The second is upon the Prism and Spectrum. We pass these by and confine ourselves to a brief resumé of some of the author's painstaking inquiries into the colour-relations of the several organs of plants, of the flowers of widely different Floras, and of different Natural Orders. We devote the space to this the more willingly, that we believe such inquiries carefully carried out, and resting upon a basis sufficiently broad, often afford unexpectedly interesting results. In connection with the special inquiry pursued by Hr. von Martens, such results can hardly be said to have been as yet forthcoming, though this may be attributable to its neglect by competent botanists rather than to any cause more deeply seated. Since the observations of Professor Dickie, recorded in the Annals of Natural History* some eight years ago, we do not recollect any contribution of scientific importance upon the colour-relations of plants in our own or foreign journals. Prof. Dickie's paper was especially upon the complementary relations of colours in the individual and the relation between the form and colour of organs,—branches of the subject which do not appear to have specially engaged the attention of our author.

In the third chapter we have a description of the Chromatic Table, similar to that in Chevreul's well-known work, which accompanies the essay. It is a circular disc divided by twenty-four equi-distant radii into as many wedges, each coloured in one hue and decreasing in intensity from the centre to the margin in eight degrees of tone—(Farbentonleiter—*Gamme*, Chevreul). Some such chromatic table is essential in inquiries of this kind, and until a better be decided upon, we are content to pin up Hr. Marten's disc in our plant room, and to respect his nomenclature with but few exceptions, which do not detain us now. In the eleven succeeding chapters, the several organs of the plant are seriatim examined with respect to their colour-phenomena. We have not, generally, the successive changes traced through which the plant or an individual organ passes from youth to age, but commencing with the lowest member of the structure, the root, and continued through stem, leaf, flower, fruit and seed, we have recorded several observations of considerable interest, among the more important of which are those upon the colour-relations of the flowers of different Floras. In Hr. v. Martens' method of collating these we find some awkward peculiarities which the friendly revision of some practical mind might perhaps have spared him. Thus he gives us the total number of flowering plants of a given area, then deducts the apetalous and glumaceous species, and those destitute of petaloid perianth; then, whatever be the number of these species bearing flowers of two colours, we have such number added to the above. The proportion of this new total with white flowers is next stated, and then follow the percentages of the respective colours based upon their own total, remaining after the white-flowered species are deducted. It may be all very well to put the matter in this way, but certainly not only thus.

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* Ser. ii. xiv. 401.

The relative prevalence of the several colours is inquired into under the heads of (1) the wild and cultivated species of Würtemburg, (2) the Flora of the Alps, (3) of Greenland, (4) of Spitzbergen, (5) of the littoral Flora of Europe; and, further, in respect to the season of the year; the various natural orders; and, finally, the odour of the flower. It is to be regretted that our author should have been willing to accept to so great an extent as authority for the colour of the flowers of the various Floras treated of, the plates of 'Flora Danica' and the works of Jacquin and Sturm. As to the species of Greenland, he acknowledges himself wholly indebted to the plates of 'Flora Danica,' while the colours of Spitzbergen flowers were adopted, in turn, from their Greenland and Alpine representatives. With such guides it must have been impossible to avoid much error, especially in the attempt to classify the flowers according to their depth of tone.

The Flora of the Alps includes 481 species, of which 93 are reckoned as apetalous or glumaceous. Deducting these, Hr. v. Martens adds 61 to the remaining 388, 61 being the number of species bearing two-coloured flowers. 115 of the 449, or a little above one-fourth, are white-flowered. These are deducted, leaving 334 with coloured perianths. Yellow obtains more or less in 35 per cent. of these, blue in 40 per cent., and red in 47 per cent. This apparently small proportion of the yellow series is explained by the independence of this colour in Alpine flowers. While 13 species have flowers of pure blue and but two pure red, 108 are pure yellow. On the other hand, of yellow in combination, but 44 tend towards red and 4 to blue, while 163 exhibit various combinations of red and blue. In the Greenland Flora 329 species are reckoned,* of which 137 are destitute of petaloid perianths. 69, or more than one-third, of the remaining 192, are white-flowered. 51 are pure yellow, 11 yellow mixed with red, and 5 yellow with blue. There are no pure red flowers, and but 2 pure blue, though there are 58 of shades intermediate between blue and red. But 74 Phanerogams are known to the author from Spitzbergen. As in Greenland, yellow greatly predominates, both in purity and frequency.

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* Reduced in Dr. Hooker's "Arctic Flora" to 281 species.

In regard to the littoral Flora, which Hr. Marten believes to present a greater contrast than any other in Europe with the Floras of the Alps and Arctic Circle, comparisons rest on the species growing on the shores of Denmark, Germany, and Italy. This peculiar Flora includes 217 Phanerogams, 87 of which are apetalous or glumaceous, and 25 are white-flowered, leaving a balance of 105 with coloured perianths. Of these, 4 species are two-coloured, 21 are pure yellow, 17 yellow and red, 3 yellow and blue, with 1 pure red and 1 pure blue, against 59 intermediate between red and blue. Compared with Greenland, it is shown that, in the littoral Flora, the proportion of species, destitute of coloured perianth, is about the same: the chenopods of the sands balancing the sedges of the snow. That the white flowers are only about half as numerous, the yellow fewer, the red rather more, and the blue nearly twice as numerous. In the species of the Württemberg Flora, the largest proportion with white flowers expand in spring, and suggest the notion that the lower the temperature, the more numerous they become. Red flowers predominate in autumn and summer; yellow constitute an equal proportion in spring, summer, and autumn; while blue, like white, decreases from the first.

Of the species with agreeably scented flowers growing about Württemburg, the largest proportion are white-flowered, the second red. Pollen is almost always yellow, or some colour in which it forms part. The few observed exceptions are recorded. Finally, the principal groups of Cryptogams are severally noticed in respect to their colour-relations.

Original Articles.

XX.—HEINRICH RATHKE.—ON THE DEVELOPMENT OF THE CRANIUM IN THE VERTEBRATA.

[The active and long continued labours of the head and founder, after Van Baer, of that modern science of Embryology which is the necessary precursor of all philosophical anatomy worthy of the name, are now unfortunately ended, Professor Rathke having died suddenly and unexpectedly while presiding over the Scientific Congress which met in Konigsberg three years ago. So long as the venerated master lived, it behoved those who had learned so much from him respecting the development of the vertebrate skull to wait for the fulfilment of the promise half given in the opening paragraphs of the masterly essay here translated. But there is no sign that any larger work on this subject remains among the papers of the deceased philosopher, and therefore, the translator, imagining that others may find it as difficult as he has done to procure the original "Vierter Bericht über das naturwissenschaftliche Seminär bei der Universität zu Königsberg—nebst einer Abhandlung über die Entwickelung des Schädels der Wirbelthiere," published at Konigsberg thirty-four years ago, (1839) offers this version of a memoir which is at this moment the best and most comprehensive account of the development of the skull extant. Hereafter the translator will take occasion to point out how far later inquiries by Rathke, or by others, may necessitate the modification of some of the paragraphs of this essay.—T. H. H.]

§ 1. WHILE occupied during the last few years, with investigations into the development of the Snake, I was much surprised at the mode in which the formation of the skull commenced—and I was thus induced to examine the same process in other vertebrata; the more especially as I entertained the hope that the study of its development would tend to elucidate the view that the skull is composed of several modified vertebræ.

But in putting forth the results of the observations bearing on this question, which I have made, it must be remembered that they are but the outlines of a work, which I propose to complete by further researches.

§ 2. If any trustworthy result is to be attained from attempts to explain the skull as consisting of several modified vertebræ, they must be based on an acquaintance with the development of the spinal column. Therefore I shall premise an account of the most essential steps in the development of that part.

§ 3. That which constitutes the foundation of the spinal column, is the notochord, a membranous tube, closed on all sides and filled with a gelatinous substance. Hence the notochord consists, in and for itself, of two different parts which may be termed the axial substance and the sheath. Round it is deposited a blastema, which at first, has the same coarsely granular composition throughout. It seems to make its appearance first on the right and left sides of the notochord, and then gradually to grow above and below round the notochord, so that after a certain time, the latter is coated with it, as by a new or second sheath. However this may be, the substance of this blastema, which I term the *Investing mass of the notochord*, very soon increases, chiefly in thickness, on each side; the thickening not being alike in all parts, but in some places thicker and in others thinner. This takes place in such a manner, that, on each side, a multitude of small plates are formed, of which each pair have a small, thinner, interspace. By degrees the plates grow towards one another above and below, and at last each pair coalesce into a ring. Consequently after a certain time the notochord is seen to be inclosed within a number of such rings, which lie in a series one between the other.*

But before the plates thus coalesce into rings, the investing mass of the notochord, whence they are developed, grows upwards on the two sides of the future spinal cord, within the dorsal laminæ, and here also attains, in one spot a greater, in another a less, thickness. These thicker and thinner spots correspond with the similar parts of the investing mass on the two sides of the notochord, or rather are to be regarded as the prolongations of them.

Thus, after a certain time, there arises an appearance as if the just mentioned and already completed rings which inclose the notochord, had sent up rays to embrace the spinal cord on both sides. Later still, each pair of these rays come into contact above the spinal cord and coalesce, so as to form arches, which are borne by the rings inclosing the notochord. In the tails of osseous fishes, the same process goes on towards the opposite side, but the arches thus formed inclose, not parts of the nervous system, but the caudal arteries and veins. In the trunk of osseous fishes also, the rings which indicate the bodies of the vertebræ throw out downwardly directed processes and, in certain fishes, the hindermost of these also coalesce so as to form arches; ordinarily, however, they remain separate from one another, but mark themselves off from the bodies of the vertebræ and then appear as ribs. As in Fishes, so in other Vertebrata, processes are developed from the investing mass of the notochord in the trunk, and serve to inclose the subjacent viscera more or less completely. Some of them become distinct, either close to the rings, from which the bodies of the vertebræ will be formed, or at some distance from them, and are either developed into ribs only, or into ribs and transverse processes; others do not become distinct, and acquire the character of simple transverse processes. The transverse processes which are formed in many caudal vertebræ of different Amphibia and Birds have a similar origin.

It is to be remarked that in some Amphibia, below these transverse processes, additional paired processes are formed, which in the Crocodiles coalesce into arches, but in the Snakes remain separate and serve to inclose a caudal artery and vein. They correspond in position and form to the similarly named parts in fish, the transverse processes in question being new parts, which are wanting in Fish. Furthermore, the ribs of the higher vertebrata do not correspond with the ribs of Fishes, which are seen to pass gradually into their inferior caudal arches, but are, as Johannes Müller has conclusively demonstrated (Vergl. Anat. der Myxinoiden Theil. 1. p. 93—100.) parts of a peculiar nature, absent in Fish and arising higher up on the vertebral centra than the ribs of these last animals.

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* Whether in many or in most Vertebrata two series of such plates, an upper and a lower (which however soon coalesce), are developed on each side, as is said by Von Baer to be the case in *Cyprinus blicca* requires further investigation. It is certainly not the case in the Snake.

§ 4. The rings, developed from the investing mass of the notochord, which have been described, gradually thicken and broaden on all sides, become filled up by a mass similar to that of which they originally consisted, and change into vertebral centra; the notochord, becoming more and more constricted where it is inclosed by them and at length disappearing. In Amphibia, Birds and Mammalia it, at length, entirely disappears, but this is not the case in all osseous fish. In all these animals, however, a part of it remains between every pair of rings or vertebral bodies. The sheath of this part becomes an intervertebral ligament, while the axial portion is liquefied, and then appears as a more or less viscid synovial fluid, or, as in Mammals, may be entirely absorbed.

§ 5. Each vertebral body, together with its different processes, though at first entirely consisting of granular blastema—gradually becomes cartilaginous and, even in this condition, it occasionally happens that all its parts form one continuous whole. But if a process becomes distinct, as a rib, the mass becomes membranous at the point of demarcation.

The rest of the investing mass of the notochord which has remained between the vertebral centra, almost always becomes membranous, (very rarely, as in the most anterior part of the spinal column of the Sturgeon, also cartilaginous), covers the intervertebral ligaments, and then appears continuous with the periosteum of the vertebral body. The same process appears to take place in those parts which lie between successive spines and neural arches, the intercrural and interspinous ligaments appearing to be developed here.

§ 6. It results from existing observations that the ossification of the vertebral bodies begins at different points and proceeds in different modes. In each crus of a neural arch, however, only a single centre of ossification is developed, which gradually elongates, so that, at length, the entire crus appears ossified, whereupon it anchyloses with the bony deposit in its centrum. In each rib also, ordinarily, only one centre of ossification is developed, and this extends in such a manner, that in many animals, the entire rib ossifies, while, in others, only the greater part of it is converted into bone, the lesser moiety remaining cartilaginous, and forming what is termed the costal cartilage. In Birds, on the contrary, two ossific centres appear in almost every rib, one for the upper half, the other for the lower half; the latter corresponding to the costal cartilage, and receiving the name of a sternal rib.

§. 7. What has been stated respecting the development of the vertebral column relates only to the ordinary process. From this, however, there are many and sometimes important departures. And inasmuch as these may be of importance in making a comparison between the spinal column and the skull, I shall here give a brief account of the chief of them.

§. 8. In the Myxinoids and in *Ammocœtes branchialis*, the investing mass, which immediately surrounds the notochord, becomes every where metamorphosed into a moderately thick fibrous membrane, which completely ensheathes the notochord. From the sheath two plates of like texture pass upwards to embrace the spinal cord and to unite above it. *Petromyzon* exhibits a somewhat higher development. The notochord and spinal marrow are inclosed within a similar fibro-membranous investment, but there is, in addition, a slight indication of proper vertebral bodies, which consists in two very narrow and short cartilaginous striæ, into which the basal part of the occipital cartilage is prolonged posteriorly, and which are situated on both sides of the notochord, on the above-mentioned fibrous sheath. They may be regarded as indications of many coalesced vertebral bodies; and the more so, as on each side, immediately behind them, a short longitudinal series of a few very small cartilaginous plates appears, representing the separate lateral halves of a corresponding number of vertebral centra. Notwithstanding that only these scanty traces of a few vertebral centra appear in *Petromyzon*, cartilaginous vertebral arches are developed in great numbers, embracing the spinal chord and fixed upon the external, almost wholly fibro-membranous sheath of the notochord ; being inclosed in the substance of the two fibro-membranous plates which pass from that sheath upwards, to inclose the spinal chord laterally.

In the Sturgeon we have a still higher grade of development, though not so high as in the Plagiostomes. Not only are the crura of vertebral arches present, as in *Petromyzon*, but far more definite rudiments of vertebral centra make their appearance, consisting, (if we except the four or five anterior vertebræ) for each vertebra of four larger or smaller, more or less distant, cartilaginous plates closely united with the fibrous sheath of the notochord ; viz., of two upper and two lower ones, so that on each side an upper and a lower series of such plates runs along the spinal column. From the upper ones, the cartilaginous vertebral arches proceed, and ribs pass as immediate prolongations of a few of the lower ones, whilst with others, especially the most anterior, the ribs are moveably articulated. The four or five most anterior centra consist each of a perfectly closed ring, which has without doubt arisen from the gradual increase and ultimate coalescence of the four cartilaginous plates.

The structure of the vertebral column of the Sturgeon shows plainly,that in these Fishes, the investing mass of the notochord gives rise, on the one hand, to a fibrous sheath, on the other, to four different cartilaginous plates closely united with that sheath, so that each lateral half of a centrum primitively consists of two portions. Perhaps the investing mass of the notochord may develope in a similar manner in some other vertebrata; since primarily, before chondrification, it thickens on each side in two places, and then the two thickenings approximate and coalesce.

§ 9. Another deviation from the ordinary mode of development is to be seen in the spinal column of certain tail-less Batrachia, namely of *Rana paradoxa* and *Bufo obstetricans*. In these the vertebral centres are developed, not from complete cartilaginous rings, but from half rings, which lie on the notochord and only partly inclose it, since they leave its under side uncovered.

§ 10. A third deviation is presented by the spinal column of the Sharks. It is usual in Vertebrata to find the interspace between two adjacent vertebral arches filled only by fibrous membrane, the *ligamentum intercrurale.* But in these animals, there is, in almost every such interspace, an additional oblong plate of cartilage, which resembles a neural arch in form and size. Similar but much smaller intercalary cartilages are seen in the Sturgeons.

§ 11. Lastly, it is to be noted, that the nerves which the spinal chord gives off laterally, usually pass between the neural arches of the vertebræ, while, in the Sharks, they traverse the neural arches themselves, so that each crus exhibits a foramen for the passage of a nerve.

§ 12. The anterior, more or less pointed end of the notochord penetrates into the skull, and contributes to form the lower wall of the future brain case. Probably, without any exception, it extends only to between the pair of vesicles (more or less open towards the cranial cavity and chondrifying very early), which belong at first to the lateral walls of the brain case, and developing into the skeletal parts of the auditory labyrinth—change their form, as they grow, but little in a few cases—while, for the most part, they become much altered.

Within the lower wall of the brain case there now accumulates around the cephalic part of the notochord, and probably at first to the right and left of it, a coarsely granular blastema, forming two thin streaks, which, as it were, fringe the part of the notochord in question, and then become converted into cartilage. That such is the case is rendered probable by the structure of *Ammocœtes branchialis*, in which animal the development of the skull is at its lowest stage. The direct study of the development of various Vertebrata has, however, yielded no certain results upon this point; on the contrary, the cephalic part of the vertebral column, when such a blastema destined for the formation of the skull was deposited, was surrounded by it as by a sheath.

The further morphological relations of this sheath, or of the investing mass, are remarkable, and are different in different animals.

Setting aside a few Cyclostomes, the mass in question accumulates more especially on the two sides of the cephalic part of the notochord; so that the sheath which it forms acquires, as it were, two wings, which likewise are situated within the other and less coarsely granular substance of the base of the capsule, which encloses the brain and its membranes—in other words, they are situated in the future basis cranii. They attain a different relative breadth in different vertebrata, but in general are larger and broader than the third cerebral vesicle, which lies over them and the cephalic part of the notochord. Hence their origin appears to be connected with the circumstance that the capsule, formed by a part of the serous layer of the germ, which contains the brain, is necessitated to acquire a much greater breadth than the capsule surrounding the spinal marrow.

Furthermore, the investing mass of the cephalic part of the notochord is continued forwards for a certain distance beyond this part—the sheath which it forms, and its two wings, passing into a horizontal plate, which also forms a part of the basis cranii, and reaches almost close to the posterior end of the infundibulum. Here, however, it divides, or rather sends out certain processes, the number of which is different in different animals. In Fishes and Batrachia only two such processes occur, and these are situated in the lateral halves of the skull, and have a similar form and direction. They lie enclosed in the general gelatinous basis cranii, extend even originally, in all probability, not merely as far as the anterior end of the latter, but also a certain distance beyond it. Posteriorly, they lie at a moderate distance from one another, but at the anterior end of the brain case (while this has still a generally gelatinous consistency), they come close together, and, in front of it, bend outwards like horns. Two similar processes occur also in all the higher animals. But, in addition to these, in the earliest period of the fœtal life of these last, a third, azygos process is present, which passes off between the two first from the anterior edge of the tabular projecting part of the investing mass. It is shorter than the two others and projects into the cranial cavity, being bent upwards and forwards. Its convex side is directed forwards, its concave side backwards, and it lies between the first and third cerebral vesicle in the deep sinus, which the brain of all animals above the Batrachia forms—by bending upon itself—and by its end it touches the lower wall of the middle cerebral vesicle. The brain appears in these higher animals to have been bent round the azygos process, while in Fishes and Batrachia it always retains a tolerably straight direction.

These processes, which the investing mass of the notochord sends out, may be termed the rafters of the skull (*trabeculæ cranii*).

§. 13. *a.* In the Snake, the Blindworm, the Lizard, the Fowl, the Pig, and the Ruminants, the pointed cephalic part of the notochord extends only to between the auditory capsules. It is surrounded by a dense blastema, which projects beyond it more or less laterally, but, anteriorly, extends only as far as the infundibulum, and forms a more or less thick plate, which afterwards chondrifies, whilst that part of the chorda itself, sooner or later, disappears, without leaving a trace behind. This disappearance takes place soonest in the Mammalia, latest in the scaly Amphibia. From the plate in question pass three trabeculæ, at first consisting of condensed blastema, afterwards of cartilage, which are proportionally very thick.

The azygos one which passes upwards, and is situated in the interspace between the anterior and the posterior cerebral vesicles, in time disappears altogether; for the posterior clinoid processes of the sella turcica, which are found in the higher animals, only take its place and are not developed out of it. The paired trabeculæ cranii extend at once to the lower part of the primitive wall of the forehead, out of which gradually the so-called frontal process of the head (a part of the face) is developed, and here they are closely approximated; in the rest of their course, however, they are more or less widely separated. Of this, one may convince oneself by the examination of embryos of the animals mentioned above, even of Mammalia, while they still possess branchial clefts. Between the trabeculæ the basis cranii is very much thinner, and its texture is not so granular; and, through the posterior part of this, or the gap of the basis cranii, as it might be called, the oral mucous membrane is protruded towards the cranial cavity to form the pituitary body.

b. The further development of the basis cranii is different in the different animals which stand higher than the Batrachia. The two trabeculæ, before they chondrify completely, approximate for a greater or less distance and coalesce. In the different higher animals, however, this happens for a greater or a less distance. In Mammals they unite very early throughout their whole length. In the chick there lies between them posteriorly, when the pituitary body has been formed (even after the feathers have begun to develope), a very large rounded gap, filled only by connective-tissue (*Zellstoff*).

In the Lizard there exists at the same spot, even at the end of fœtal life, a somewhat larger but triangular gap filled with connective-tissue. A still larger and elongated space of the same kind remains between the posterior parts of the trabeculæ in the Blindworm up to the end of fœtal life.

Among the higher animals the cranial development of which I have examined, however, it remains longest and largest in the Snake; for in this animal it extends, even late in life, as far as the anterior end of the brain-case, though it is very narrow in its anterior half even in the middle of fœtal life.

Furthermore, the originally separate parts of the trabeculæ become longer the greater the size attained by the eyes: these parts consequently remain shortest in Mammalia and are longest in Birds and Lizards.

Yet another difference in their further development depends upon the extent to which the eyes increase in magnitude. If these acquire a considerable volume, as is especially the case in Birds and Lizards, they approach one another more and more, and thrust the anterior part of the brain upwards, so as to remove it further and further from the trabeculæ, which have already coalesced for a greater or less distance. In consequence of this operation, the coalesced trabeculæ send upwards a perpendicular plate, which forms a septum between the eyes, and either consists entirely of cartilage, or, to a certain extent, also becomes membranous. Among the animals the development of whose skulls I have examined, this plate exhibits its proportionally greatest height in the Chick, the smallest in the Blind-worm.* In the Snakes and Mammalia, however, it is not even indicated; on the contrary, in them the brain remains lying directly upon the trabeculæ of the skull.

c. The ossification of the basis cranii takes place in the Snake, the Blind-worm, and the Lizard, on the whole, in the same way.

The basi-occipital is formed by the ossification of the previously chondrified investing mass of the cephalic part of the notochord, as well immediately around this part, as in its two wings or lateral expansions, by which a bony plate is produced, which anteriorly hardly extends perceptibly beyond the notochord, and at first encloses it, as its axis. Gradually, however, the cephalic part of the notochord disappears, and the space which it occupied becomes filled by a growth of the bony substance in question. Hence, in these animals, the basi-occipital is formed in just the same way as the body of a vertebra, and the differences between them relate mainly to external form, the basi-occipital being much broader, in relation to its thickness, than an ordinary body of a vertebra; it is, in fact, a plate and not a cylinder.

A second bony plate appears at a considerable distance in front of the first; namely, in that half of the investing mass which projects beyond the cephalic part of the notochord, close behind the three trabeculæ, which pass forward as processes of this mass. This second bony plate is the basi-sphenoid. At first, as has been said, it lies at a considerable distance from the first plate; gradually, however, it approaches the latter more and more, whilst, on the one hand, new bony matter extends from it posteriorly into the investing mass, and on the other, the basi-occipital grows in the same manner towards it. In time the two bony plates come into contact and coalesce. The basi-sphenoid, therefore, though it is still in the investing mass of the notochord, does not arise in quite the same manner as the body of an ordinary vertebra, since it never incloses a part of the notochord, but rather is formed in front of the notochord, and from the very beginning represents a quite dense thick plate. Neither can it be united with the basi-occipital as the vertebral centra are united since a part of the sheath of the notochord is an essential part of such union (§ 4).

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* In many osseous fish, a similar, very large and high septum is formed. It is probably largest of all in the Sword-fish, whose eyes have such a prodigious size.

The pre-sphenoid is developed from a cartilage which is no longer a part of the investing mass of the notochord, but arises quite independently of it.

In the Snake, this cartilage is developed within the mucous tissue (*Schleimstoff*) which fills the long gap left by the non-coalesced trabeculæ cranii, and it assumes a form corresponding with that of the gap, being a narrow, moderately thick, anteriorly pointed, and altogether almost stilet-shaped body. When it has ossified, however, its posterior end grows broader, and changes into a little plate, which, growing towards and abutting against, the margin of the basisphenoid, eventually coalesces with it. When this has taken place, the presphenoid appears partly as a spine, into which the basis cranii passes anteriorly. For the rest, in the Snake, the posterior parts of the trabeculæ cranii, between which the presphenoid arises, increase not a little in length and thickness, and remain recognizable, throughout life, as two rounded cartilaginous spines converging anteriorly, lying close on each side of the presphenoid and passing immediately from the basisphenoid.

In the Blindworm, the development of the basis cranii takes place, on the whole, as in the Snake. In the Lizard, in which the trabeculæ cranii very soon coalesce throughout almost their whole length, the presphenoid is formed, not, as in the Snake, in the gap which remains between these trabeculæ, but before it and at its under side, or rather along the lower edge of the cartilaginous orbital septum, which has become developed out of the coalesced parts of the trabeculæ. The reason of this probably is, that, in the Lizard, at the time when that bone arises, the gap in question is very short and lies only quite posteriorly under the pituitary body. The form, again, which the body of the presphenoid assumes in the Lizard is different from that in the Snake; for, in the former, it is a narrow and very thin bony lamella, which, it may be remarked in passing, is lost with the septum when the skull is macerated too long.

Although, now, the presphenoid of Snakes and Lizards, as regards its position and form, arises in a somewhat different manner; yet, in all, its mode of origin is far more different from that of an ordinary vertebra, than that of the basisphenoid, and, in fact, is quite distinct; since, on the one hand, the presphenoid has no such relation to the notochord and its investing mass, as has the body of a vertebra; while, on the other hand, it has, from the beginning, a form altogether distinct from that of a vertebral body.

In the Fowl, the bones which constitute the floor of the brain-case are developed essentially in the same way as in the Lizard. The presphenoid arises also at the lower margin of the cartilaginous septum, which separates the eyes, in front of the gap which has persisted below the hypophysis cerebri and between the paired trabeculæ, and has, at first, the form of a moderately long, narrow, and thin grooved plate, in which that septum as it were rests. Soon, however, it becomes thicker, elongates further backwards, coalesces a short time before the end of fœtal life with the basisphenoid, which grows somewhat towards it, and then represents a moderately thick, tolerably long spine, provided at its upper end with a groove, proceeding from the basisphenoid, and aiding it to close inferiorly the gap, which previously lay under the pituitary body. It should be especially noted that the presphenoid of the Chick is developed from a thin lamella of bone, which plainly arises between the primarily cartilaginous orbital septum (produced by the coalescence of the trabeculæ) and its perichondrium. In the Chick, as in Snakes and Lizards, the body of the basisphenoid is formed in the investing mass just in front of the notochord.

The basioccipital also arises in the same way as in these Reptiles. At the time when the cephalic part of the notochord still persists, bone is deposited around this part in the investing mass, and then from this point ossification proceeds right and left.

In Mammals, according to my examinations of Ruminants and Pigs, the basioccipital is formed in the region in which the cephalic part of the notochord lies; yet only after this has disappeared. The basisphenoid arises, to judge by the adjacent parts, in the point where, at an earlier period, the anterior part of that plate which is formed by the investing mass lay.

A special presphenoid, however, appears not to be formed in Ruminants and Pigs; for I have been able to observe none in these animals, even when all the four already ossified alæ of the sphenoid and the body of the basioccipital possessed a considerable size, and the vomer reached almost to the basisphenoid.

In new-born moles, also, I have observed no presphenoid.

Kerckringius was led to the same result by his investigations into the development of the human skeleton;* and in Nicolai's work on the same subject ('Beschreibung der Knochen des Fœtus') only one body of the sphenoid is spoken of. In Ox embryos, with heads 15 to 18 lines long, and in which each orbitosphenoid already possessed two large roots embracing the optic nerve, both bones came into contact by these roots, and the basisphenoid, which lay between the alisphenoids, pressed close against the latter. I am therefore led to believe, that the whole presphenoid of these Mammals arises by the coalescence of the roots of the orbitosphenoids, partly with one another, partly with that piece of bone which lies behind them and between the alisphenoids, and that this bone then grows further and further forwards below them. In new-born Kittens, on the other hand, I saw a special presphenoid quite distinctly.† A similar bone seems to occur in many other Mammalia, so far as I could make out from their fully developed skulls—viz. in the Seals,

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* Osteogenia fœtuum.

† Whether it had arisen between the trabeculæ cranii or out of their substance could no longer be made out.

Solipedes, and Rodents; but further investigations are required for the clearing up of this point.

d. The exoccipitals certainly arise in the Reptilia, Birds and Mammals, in just the same manner as the neural arches of the vertebræ: in fact they appear not merely in their gelatinous, but also in their cartilaginous condition, as radiations from the investing mass of the cephalic part of the notochord. Indeed, in many animals, viz. Snakes, Lizards and the Blindworm, their upper ends even, like those of the neural arches of a vertebra, come into contact with one another, and then coalesce. In those higher Vertebrata however, in which the brain attains a greater volume, they do not meet, and there is developed between them a special os intercalare, the supra occipital.

On the contrary the ali- and orbito-sphenoids never arise by the outgrowth of chondrified parts of the basis cranii; for they grow neither out of the trabeculæ, above which they appear, nor out of the basi- or pre-sphenoids, when these different parts are in the cartilaginous condition; but they are formed separately in the originally gelatinous lateral walls of the brain case.

In Lizards the alisphenoid appears at best only as a thin bony plate, (the *columella* of Cuvier) and the orbito- sphenoid is entirely wanting, whence, in these animals, that half of the lateral walls of the brain case which lies in front of the petrosals remains almost entirely membranous.

Neither in Birds are any separate orbito-sphenoids formed. On the other hand, the frontals, as they increase in size, abut against the cartilaginous orbital septum and then coalesce with it, when at the end of fœtal life it ossifies, as I shall show below.

e. I have stated above that the paired trabeculæ cranii, in those animals which are above the Batrachia, meet anteriorly at a very early period and then separate again, forming two little cornua. This anterior coalesced part, with its cornua, lies where the lower wall of the capsule which now invests the brain and which will become the cranium, passes into the anterior, or the frontal wall—at the spot, in fact, where the so-called frontal process of the head, a part of the face, is developing. On both sides of the most anterior part of the trabeculæ, and in fact close behind their cornua, the olfactory sacs are formed. Whilst these increase in size, the paired trabeculæ of the skull coalesce between them, become cartilaginous and grow into a plate the length and height of which correspond with those of the olfactory organs of the animal. This plate is the nasal septum.

In those animals, in which, from a similarly coalesced part of the paired trabeculæ cranii, an interorbital septum has also been formed, viz. in Lizards and Birds, the two septa pass uninterruptedly into one another, so that the one may be regarded as a continuation of the other, or rather, the two make one whole.

From each side of the upper edge of the septum narium there grows out very early (even before it chondrifies), at almost a right angle a nearly horizontal thin plate or ala, which also chondrifies, and after a time appears convex on the upper, concave on the lower, side and covers the olfactory membrane more or less completely. Close upon these newly arisen horizontal cartilaginous plates, however, which can also be recognized in perfectly adult animals, the nasal bones are formed.

Another, but azygos bone is formed in Mammalia on the lower edge of the cartilaginous nasal septum, and in fact between the cartilage itself and its perichondrium. This is the vomer, which, at first, in all cases, forms a simple grooved bone, in whose channel the nasal septum lies, just as in Birds the original cartilaginous orbital septum lies upon the presphenoid.*

Such a bone is formed in this place in many Birds. On the other hand, in Amphibia and Reptilia a vomer never appears. The bones which have been regarded as such have a totally different nature. Immediately in front of the coalesced part of the trabeculæ, finally, between the cornua into which it is produced, the premaxilla is formed distinct from those cartilaginous parts. In the Snake it is from the beginning single, but in other Vertebrata it originally consists of two symmetrical halves.

f. With respect to the cartilaginous and bony parts of the olfactory apparatus, my investigations have yielded the following results. The cartilaginous septum narium, which has arisen by the coalescence of the anterior parts of the trabeculæ, very early sends out from its upper edge, as has been already stated, a plate which curves round the upper side of the olfactory sac. It attains its smallest volume, among those animals which stand above the Batrachia, in the Snakes; the largest, in Mammalia. In the Reptilia it arches only over the upper side, in Birds and Mammals also round the outer side, of the olfactory sac. A part of it is developed in many Birds, (*e. g.* Gallinaceæ) into the cartilaginous squama which covers the nasal aperture, in Mammalia into the cartilaginous rudiment of an ala nasi. Furthermore, in many of the Vertebrata above the Batrachia, it sends in, towards the cavity which is invested by the olfactory membrane, lamellar outgrowths, in greater or smaller numbers, which lie in folds of that membrane and form the turbinals.† Besides this, in Mammalia, a part of this plate applies itself in front of the exit of the olfactory nerves from the cranial cavity, and forms the basis of one lateral half of the lamina cribrosa of the ethmoid, while in Birds and Reptiles this is not the case.

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* The origin of the vomer and of the presphenoid between a cartilage and its perichondrium is otherwise remarkable, because, often when a destroyed bone is to be reproduced, the development of bone proceeds from the periosteum.

† In my Essay on the Development of the Olfactory Organs of Mammalia (Abhandlung z. Bildungs- und Entwickelungs-Geschichte d. Thiere), the origin of the turbinal bones from the two cartilaginous plates, which proceed from the septum narium was described at length. In a very large exotic Frog (*Rana ocellata*) I observed, that the large bony turbinal, which occurs in this animal, was developed not from the upper, but from the lower plate of the nasal septum, which is united with the palatine bones and is peculiar to Batrachia.

At certain points of the two plates of the nasal septum in question, the gelatinous substance of which they originally consist, is not chondrified, but becomes membranous. Of the cartilaginous mass of these plates, however, certain parts become changed, especially in Mammals, into bone, and are further developed into the olfactory turbinals, the lamina cribrosa and the lamina papyracea of the ethmoid.* The septum itself which sends out the plates also partly ossifies in Mammals, and this, its ossified moiety, then appears as the bony part of the nasal septum, together with the crista galli, the foundation of which last had been laid by a prolongation of the originally merely cartilaginous septum.

On the other hand, this septum does not ossify in the Reptilia, nor, as a rule, in Birds, but remains permanently cartilaginous in them.

In Birds, however, at the end of fœtal life, at least the anterior part of the cartilaginous orbital septum, which is continuous with the septum narium, ossifies. The osseous plate, which is thus produced, and which is commonly regarded as a part analogous to the ethmoid of Mammals, coalesces in most Birds with the anterior half of the body of the sphenoid.

The premaxillæ arise, as was before mentioned, between the two cornua, into which the external part of the paired trabeculæ is produced anteriorly. If the horizontal part of the premaxillæ, which grows towards the maxillæ, acquires a considerable size it applies itself to the under surface of those cornua, which at the time when the nasal septum is developed proceed from its lower marginal portion. The cornua in question are found even in adult animals, especially in Ruminants, the Horse, and many other Mammals.†

§ 14. In the larvæ of *Rana viridis* and *Rana temporaria*, the cephalic part of the notochord extends, also, only to between the auditory organs—tapers but very little however, and ends by a very short point. The investing mass forms a broad and moderately thick plate, which projects beyond it, forwards, almost to the pituitary body, and remains merely cartilaginous up to the very end of larval life. In larvæ whose hind legs have but just budded, this cartilaginous plate has only a small thickness; sends upwards, behind the auditory capsules, two small processes (the lateral parts of the occipital bone) and is continued forwards into two, also very thin, cartilaginous bands or trabeculæ. The two latter are tolerably broad and are separated by an oblong gap which is much broader than either. The gap is filled up by a very delicate membrane which appears to consist of the dura mater and of some cellular tissue. Quite at the anterior end of the brain case the two bands unite, but coalesce only for a short space, and then separate at a not very acute angle. These anterior diverging parts, which belong to the face, have a considerable length, are about half as broad as they are long, and anteriorly are obtusely rounded off. At their sides and quite posteriorly, where they pass off from the coalesced part of the trabeculæ, are the nasal apertures and cavities. The anterior ends of both however come into contact with the semilunar pieces of cartilage which constitute the upper beak of tadpoles. In front of the auditory capsules, the lateral walls of the cerebral capsule are slightly chondrified, but the entire upper wall of the brain case is membranaceous.

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* Hence it follows that the capsules which in the Snakes inclose the nasal glands cannot be the equivalents of the ethmoids of other animals.

† I have given figures of these parts in the Snake in my account of the development of this animal.

As regards the further development of the skull, the cephalic part of the notochord persists until almost the end of larval life, but the investing mass, which immediately surrounds it, remains throughout life cartilaginous, so that a basi-occipital is never formed.

On the other hand, the two processes which the mass has sent out close behind the auditory capsules (the exoccipitals) ossify long before the end of larval life. But far earlier than this happens, a thin cartilaginous plate of considerable length and moderate breadth is developed, for the most part close beneath the cellulo-membranous substance, which, as a delicate membrane, fills the space between the paired trabeculæ cranii, and for a less extent, immediately under the anterior part of the cartilaginous plate, from which those processes are continued, (in part therefore beneath the investing mass of the notochord,) and at its posterior end sends out at right angles two short and broad arms. Soon after it appears it ossifies and then, as in osseous fishes, takes the place of the two sphenoidal bodies of the higher animals. Reichert believes that this plate is developed from the mucous membrane of the mouth, and that it has nothing to do with the sphenoid bones of the higher animals. ('Entw. Geschichte des Kopfes d. nackten Amphibien,' p. 35.) But it is only loosely connected with the mucous layer, and more closely with the parts of the base of the cranium already mentioned which overlie it; further, in old larvæ and in adult Frogs, the fibrous membrane of the cartilaginous and bony parts beside it (viz. of the occipital bone and of the trabeculæ) is seen distinctly to be continued under it; and finally, the independence of this osseous plate from the mucous membrane is testified by the analogy of its formation with that of the pre-sphenoid of Reptiles and Birds.

That the bony plate in question answers to the pre-sphenoid of the higher vertebrata is shown by its arising in a similar place and in a similar manner, as the latter, viz.: in the immediate neighbourhood of the posterior part of the trabeculæ cranii, and not by the ossification of any part of the investing mass of the notochord itself. Yet by applying itself to the under side of the persistently cartilaginous plate formed from the notochordal investment, and thus protecting the brain, it takes the place in part also of the basi-sphenoid, which is as little developed in Batrachia as in Fish.

Although in many Batrachia, as for example in *Salamandrina attenuata* which I have described,* teeth are subsequently developed on the lower surface of the bony plate, which I regard as the body of the pre-sphenoid, yet this circumstance does not support Reichert's view that that plate is developed from the mucous layer of the germ, since other bones of the head, which certainly are not developed from the mucous layer, *e.g.* the upper and under jaws, possess teeth in most vertebrata.

When the osseous plate in question has begun to ossify, the substance, which fills the gap between the trabeculæ cranii, becomes converted into a very thin layer of cartilage, the edges of which pass without interruption into the much earlier chondrified surrounding parts (the trabeculæ or the investing mass of the notochord generally), and which is to be recognized even in adult Frogs. Besides this, against the rule which holds good for animals higher than the Batrachia, the cartilage grows from the outer edges of the trabeculæ into the originally membranous lateral walls of the cranium, so that, at the end of larval life, the part of those lateral walls which lies in front of the auditory capsules, together with the basis cranii, forms a deep cartilaginous groove, whilst in other animals, where the corresponding part of the lateral walls chondrifies, the chondrification goes on quite independently of the trabeculæ.

Whilst the olfactory organs increase in size, the coalesced, or anterior part of the two cranial trabeculæ gradually elongates, increasing in height at the same time, so that it forms a moderately high septum between these two organs; and it sends out on each side, not merely, as in the higher vertebrata, from its upper edge, but also from the lower, a longitudinal ridge which gradually becomes converted into a horizontal, moderately broad plate. Both plates, or lateral alæ, then partly embrace the olfactory organ of the same side, and are applied closely to it. Upon the upper plate a nasal bone is developed, while to the lower a palate bone becomes applied. The two cornua into which the cartilaginous nasal septum is produced anteriorly, bend, in the last half of larval life, outwards and backwards round the anterior edge of the olfactory sacs, become thicker, but at the same time narrower and pointed, and remain permanently cartilaginous, like the parts from which they proceed. Between the two cornua the premaxillæ are formed in the normal way. A vomer is never developed; on the other hand, at the end of the larval condition, or soon afterwards, ossification commences in each lateral wall of the most anterior part of the brain case. By the gradual increase of this deposit a pair of little bony plates is formed, which at length meet above and below and coalesce so as to form that remarkable ring which Cuvier has termed the 'os en ceinture.' But whether this part corresponds with a part of the ethmoid of the higher animals, as has been generally admitted since Cuvier's time, or whether it does not rather correspond with the orbito-sphenoids of the higher animals, can be satisfactorily answered only by the study of the development of the urodele Batrachia. The analogy with the orbito-sphenoids, structures which otherwise would be absent, is favoured by the enormous size of the bones in *Rana ocellata*, as also by the circumstance that in many osseous fishes, *e. g.* the Cyprinidæ, the ali-sphenoids, related bones, coalesce by their lower ends with one another, and not, in the regular way, with the body of the sphenoid.

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* Zoologischer Atlas von Eschscholtz, Heft. V.

§ 15. Recently, I have observed, in embryos of *Blennius viviparus*, whose yelk sac had only a moderate volume, that the notochord, as in other vertebrata, extended only to between the auditory organs, and that the part of it situated in the head, was produced anteriorly into a point, so that, in relation to its base, it had the form of a tolerably elongated cone. Yet the cavity of the cone, wide at its posterior extremity and filled by the nucleus of the notochord, did not extend to its anterior end, but only to its anterior fourth. The part surrounding the cavity, however, consisted of the primitively very thin membranous sheath of the notochord and of a somewhat thicker sheath, also forming a hollow cone, of bone, which was continued right and left into a narrow and very thin ala.

Anteriorly and laterally this wholly bony part, which constituted the basi-occipital, was inclosed by a tolerably broad but only very thin stripe of cartilage which formed a fringe round it. Hence, the posterior part of the basis cranii was in part already ossified, while, in part, it had remained cartilaginous. Anteriorly, the cartilaginous part extended in the middle line of the head as far as the pituitary body; right and left, however, it was continued much further forwards, and the trabeculæ had the form of two thin and moderately broad bands, which ran tolerably parallel with one another, and the opposed edges of which were sharply defined; the interposed gap was filled with a very delicate layer of cellular tissue, presenting no such cartilage corpuscles as those which occurred in the bands themselves. Just in front of the pituitary body, the trabeculæ united again and passed into an azygos, somewhat narrower but much longer and thicker cartilaginous process, which extended to the anterior end of the head, and here came into contact with the maxillary and premaxillary bones.

Its breadth remained pretty much the same throughout, for only quite in front did it become somewhat broader: and here, on each side, there could be remarked a small outwardly directed prolongation, these prolongations indicating the two cornua into which the coalesced part of the trabeculæ is produced anteriorly in other animals. On its under side, however, the cartilaginous process, or the coalesced part of the cranial trabeculæ, possessed a narrow and moderately deep groove, which traversed it from its posterior almost to its anterior end. Furthermore, below the gap which lay between the two trabeculæ, and beneath the posterior half of the median prolongation of these trabeculæ which has been described, there lay a long and narrow piece of bone, exhibiting on the upper side of its anterior half a tolerably strongly projecting keel, which fitted into the groove of that median cartilaginous part. Posteriorly, however, it divided itself into two pointed crura, which diverged at a very acute angle and applied themselves closely to the under side of the bony investment of the notochord; and somewhat behind its middle it sent off laterally two tolerably long and narrow alæ, which attached themselves to the lower side of the two cartilaginous trabeculæ. The oral mucous membrane passed over the under side of the whole bone, but was only loosely connected with it; whence it could be easily stripped off from the bone, which, on the other hand, was very firmly connected with the cartilaginous part of the basis cranii.

The bone in question represented the presphenoid. Just in front of it there was a much smaller bone which lay on the under side of the median prolongation of the two trabeculæ cranii, so that it was placed between this and the oral mucous membrane. It had the form of a thin, narrow, pointed, irregularly triangular plate, and had its pointed end directed backwards, its broader and somewhat thicker end forwards. The maxilla and premaxilla were in contact with the anterior end of this plate, which was the vomer. The alæ or lateral parts of the sphenoid, which still consisted almost entirely of cartilage, formed a continuous whole, neither with the body of the sphenoid, nor with the trabeculæ cranii. On the other hand, the exoccipitals appeared as immediate prolongations of the cartilaginous notochordal investment, but were already ossified to a certain extent.

In other embryos, which were almost ready to leave the parent, the vomer and the body of the sphenoid were more developed, and were very similar to those of adult Blennies. The basi-occipital had also greatly increased at the expense of the cartilaginous border which surrounded it in younger embryos; so that, of the border itself, only the anterior part was present, though tolerably broad. The bony matter had also increased immediately round the cephalic part of the notochord, and appeared as a true though magnified cast of it. Only indistinct traces were left of that part of the notochord. The trabeculæ had partly disappeared: at least, in many embryos which I examined with reference to this point, I could no longer find their middle part, but I could only observe that the cartilaginous border of the basi-occipital was produced into two short cartilaginous points, forwards, and the coalesced part of the trabeculæ into two somewhat larger and also quite symmetrical points, backwards. This coalesced part, still entirely cartilaginous, was however larger in all its dimensions than in younger embryos, and had sent off, immediately behind the olfactory organs, between which it lay, two short, moderately thick, outwardly directed processes, which supported the anterior end of the olfactory nerves. In adult Blennies, on the other hand, the part in question is entirely ossified, forms the spongy ethmoid, and consists of a middle part, the nasal septum, higher than it is thick, and of the almost pyramidal lateral parts, with their bases directed forward, and coalescent with the median part throughout almost their entire length. Each, when it is united with the median part, exhibits a short, but perfect, longitudinal canal for the passage of an olfactory nerve. Just below the middle part of the ethmoid lies the vomer. As is the case, it seems, in most osseous fishes, the coalesced part of the trabeculæ cranii, together with its lateral processes, either ossifies entirely or for the most part, and then forms a special ethmoid, which now imperfectly closes the cranial cavity in front. In the Pike, however, it persists in the cartilaginous condition, for only a relatively small bony nucleus is developed in its two lateral processes, and in the two small lateral cornua of its anterior end.

(*To be continued.*)

XXII.—THE STRUCTURE OF THE STEM IN DICOTYLEDONS; BEING REFERENCES TO THE LITERATURE OF THE SUBJECT. By Professor Oliver, F.L.S.

(Concluded from N. H. R., April, 1862, *page* 329.*)*

PIPERACEAE. Moldenhauer, J. P. Beiträge z. Anatomie der Pflanzen. Kiel. 1812, p. 5, in note. An absence of pith and medullary rays in some species.—Duvernoy. Untersuch. über Keimung, &c. d. Monocotyl. 23, tab. i.—Kunth, C. Sur le genre *Piper*, &c. Mém. du Muséum. 1818, iv. 442.—Meyer, E. H. F. De Houttuynia atque Sanrureis. 1827, p. 38, fig. 5-9.—Blume, C. L. Obs. sur la Structure des Poivres. Ann. Sc. Nat. 1827, 216. (Ext. Mem. Soc. Sc. Batavia, xi.)—Bischoff, Lehrbuch, ii. 63.—Treviranus, L. C. Physiol. d. Gewächse, i. 210.—Meyen, F. J. F. Pflanzen-Physiologie, i. 332. In the young stems of *Piperaceae* the vascular bundles are irregularly scattered, as also in herbaceous species, in which this arrangement obtains throughout the duration of the stem. In the ligneous species a regular closed ring of wood forms in the second year's shoots, enclosing the parenchym, in which the first-formed bundles are isolated. The wood zone increases in breadth with age. —Miquel, F. A. W. Commentarii Phytographici. 1838-40. On the structure of the stem, p. 3.—*Piper rubricaule.* Link. H. F. Icones Anat. Bot. 1837, fasc. ii. ix. 9-10.—Kunth, C. Bemerkungen über d. Familie der Piperaceen. Linnæa, 1839, xiii. 561. Ann. Sc. Nat. Ser. ii. xiv, 173. *Peperomia.* The stem, composed of separate ligneous fascicles, presents a Monocotyledonous structure. In arborescent and frutescent Piperaceae the wood is compact, in layers, and separated by large medullary rays. To a certain period the central ligneous bundles are distinct.—Unger, F. Ueber den Bau und das Wachsthum des Dicotyledonen-stammes. St. Petersburg, 1840. Absch. v. On the Structure and Development of the *Piperaceae.* The order possesses both a central and peripherical vascular system. These traverse the internodes parallel to each other without anastomosis; at the nodes they unite, forming a vascular plexus, in which buds and roots originate. The formation of the wood takes place solely through the peripherical vascular bundles, originating on their outer side, and consisting of new vascular fascicles, and their connecting prosenchymatous tissue. The relation of the appendicular organs to the vascular system of the stem is described. The structure of *Saururus*, *Houttuynia*, and *Chloranthus* is described.—Gaudichaud. Recherches sur l'organographie, &c., des Végétaux, tab. xiv. 1. 2. 3. 5.—Miquel, F. A. W. Systema Piperacearum. 1843. On the Structure of the Stem in *Peperomia magnoliaefolia*, *Tildenia*, *Piper*, *Artanthe*, *Chavica;* and the structure of the root, p. 7. Noting the occurrence of vascular bundles traversing the pith: in an adult stem of an *Artanthe*, about 20 of these are found in cross section; they are less crowded toward the centre of the pith. The wood is traversed by very numerous medullary rays, primary and secondary, and by dotted vessels.—*vide* also Miquel, in Martius' 'Flora Brasiliensis.'—Lindley, J. Veg. Kingdom, 515.—Henfrey, A. Elements of Bot. 533.

CHLORANTHACEAE. Griffith, W. Notulae, iv. 383.

URTICACEAE. Guillard, A. La Famille des Urticées. Presse Scient. d. deux Mondes, iii. 305. Structure of the liber, ligneous fibres, &c. —Weddell, H. A. Monog. des Urticées. Paris, 1856. Anatomy of the Stem, p. 7. Ann. Sc. Nat. Ser. iv. 7, 309. Generally, its structure scarcely differs from that prevailing in Dicotyledons, though some are remarkable from the unusual development of certain tissues. In *Urereae* the medullary plates are of great vertical extent, as also in a ligneous *Pilea* and in *Elatostema.* The numerous vessels are dotted or transversely slit-marked. The liber-cells, delicate and much elongated, are united end to end, and disposed in close concentric zones, separated by parenchymatous layers. The structure of the wood of *Laportea gigas* is described (p. 131) and figured (tab. iv.). Wood of *Gesnouinia arborea*, vide tab. iv. 10.—*Urtica dioica.* Schacht, H. Pflanzenzelle, 250, t. xi.—*Urtica.* Chatin, G. A. Anat. comparée d. Végétaux, Livr. iii. 9 (in note). Absence of medullary rays in.—*Cecropia palmata.* Miquel, F. A. W. Beobachtung über den Markkanal und die Quer-wände im Stamm der *C. palmata*, L. &c. Bull. Sc. Phys. etc. Néerland, 1838, 29-31.—Schultz, C. H. Die Cyklose, Nova Acta, 1841, xviii. Suppl. ii. tab. xiii.—Karsten, H. Ueber den Bau der. Nova Acta, 1854, xxiv. 79. With 2 plates.—Miquel in Martius 'Flora Brasiliensis,' Urticineae, 140.

—*Humulus*. Mohl, H. v. Ueber d. Bau. * * der Ranken und Schlingpflanzen. Tubingen, 1827, § 75.—Mohl, H. v. Bot. Zeit. 1855, 889. On liber of.—*Cannabis*, *Urtica*. Reissek. S. Die Fasergewebe des Leines, &c. Ext. Dkschf. K. Ak. Wiss. Wien. vi. An account of the bast-cells.

MORACEAE.—*Morus*. Gaudichaud. Voyage de la Bonite. Bot. Atlas, tab. 132, 14, 15.—*Ficus Carica*. Meyen, F. J. F. Phytotomie, 1830, tab. x. 5, 6.—*F. elastica*. Link, H. F. Icones Anat. Bot. 1837, Fasc. ii. xiv. 1-3.

ULMACEAE.—*Ulmus*. Mirbel, Sur l'origine, &c. du Liber et du Bois, Mém. du Muséum, 1828, xvi. 12, with one pl.—Schacht, H. der Baum, 194.—Henfrey, A. Micr. Dict. 'Wood.'

CONIFERÆ.—*Juniperus*, *Cupressus*, *Taxus*, *Pinus*, *Thuja*, *Ephedra*, *Larix*. Kieser, Mém. sur l'organisation des plantes, 1814, 229, tab. 21, 22, *Abies* t. 15.—*Pinus*. B. Mirbel. Élémens de Physiologie Végétale, 1815, tab. xi. 1.—Meyen, J. Regensb. Bot. Zeit. 1828, 447. Observation on the dotted cells of Coniferae. —*Abies*. Brongniart, A. Sur les tiges des Cycadées. Ann. Sc. Nat. 1829, xvi. 400, with a plate. Comparing the Structure with that of Cycas.—*Pinus*. Meyen, F. J. F., Phytotomie, 1830, tab. xiii. 1—5, 8. *Taxus*, tab. xiii. 6, 7.—Nicol, W. Observations on the Structure of Recent and Fossil Coniferae. Ed. N. Phil. Journ. xvi. 1833-4, 137, 310. *Pinus Strobus*, p. 156. *Taxus*, p. 156. *Taxodium*, p. 158. *Araucaria*, pp. 158. 314. *Salisburia*, p. 314.—*Cryptomeria*. Don, D., Linn. Trans. xviii. 172-3, and An. Nat. Hist. i. 234.—Sur deux genres de Conifères. Ann. Sc. Nat. Ser. ii. 12, 236. The wood is compact: prosenchyma very fine, the cells bearing a single row of small circular disks much smaller and more crowded than in *Pinus*. The wood of *Arthrotaxis* resembles that of *Cryptomeria*; the punctuations are less numerous.—*Araucaria Cunninghamii*. Corda, üb. d. Bau des Pflanzenstammes. Weitenweber's Beiträge z. Natur- und Heilwissenschaft. Prag. 1836, i. Hft. 2.—Link. Bot. Zeit., 1836, 734, &c.—*Pinus Strobus*. Ann. Sc. Nat. Ser. ii. v. 129.—*Pinus*. Meyen, F. J. F. Neues System Pflz.-Physiologie, 1837, tab. iii. 1-3.—*P. Strobus*. Link, H. F. Icones Anat. Bot. 1837, Fasc. i. vii. 1-5.—*Pinus*. Fasc. ii. xiii. 1-7. Icones Selectæ, 1839, v. 5-7.—*Juniperus*. Fasc. ii. xiii. 11-13.—*Taxus*. Fasc. ii. xiii. 8-10.—*Pinus*. Elementa Phil. Bot. 1837, tab. iv. 2.—Richard, A. Nouv. Élémens de Botanique, 1838, 133, Tab. ii. and iv. 6, Ed. 1846, 147.—Goeppert, H. R. Ueber die Coniferen, Arbeit. Schles Gesell. 1839, Breslau. Linnæa. Litt. Ber., 1840, 239. On the Medullary rays and wood cells of *Pinus*, *Abies*, *Taxus*, *Araucaria*, *Ephedra*. In *Ephedra* (p. 243) the smaller wood-cells have a single row of dots on each side. The medullary rays are very broad, consisting of two to four rows of cells traversing all the annual zones. Partial rays are but a single cell in breadth. —*Gnetum*. Observation on the relation of its structure to that of *Chloranthus*, (p. 244.)—Schacht. Pflanzenzelle, 438.—*Thuja.* Link, H. F. Icones Selectae, 1840, Fasc. ii. v. 11.—Goeppert, De Coniferarum Structura, 1841.—*Salisburia.* Schultz, C. H. Die Cyklose, Nova. Acta. 1841, xviii. Suppl. ii. tab. xxiv.—Schleiden. Notice of Goeppert's De Coniferarum Structurâ. Neu. Jenaer Allg. Lit. Zeit. 1842, No. 15. Principles of Botany, 45.—Quekett, E. J. Remarks on the examination of some Fossil Woods, which tend to elucidate the structure of certain Tissues in the recent plant. Linn. Trans. xx. 149. On the discs of the wood-cells.—Bischoff, Lehrbuch, ii. 61, tab. ii. 50—1.—F. J. F. Meyen, Neues Syst. Pflanz. Phys. fig. t. iii.—Guillemin, M. Markings on prosenchyma of Coniferæ. Comptes Rendus. iii. 761.—*Taxus baccata.* Mohl, H. v. Ueber d. Bau des Cycadeen-Stammes und sein Verhaltniss zu dem Stamme d. Coniferen und Baumfarn. Abh. Ak. Wiss. München. i. 399. tab. xviii. 3, 5. Longitudinal sections of the wood.—*Salisburia.* Tab. xix. 11. Longitudinal section.—*Agathis.* Griffith, Notulæ, iv. 19. On the vascular fascicles, &c.—Mohl, H. v. Bot. Zeit. 1855, 891. On liber of Coniferae.—Hanstein, J. Ueber den Bau des Dicotylen Holzringes. Pringsheim's Jahrb. i. 248. The relations subsisting between the arrangement of the leaves and the wood-structure in *Taxus*, *Podocarpus*, *Cryptomeria;* with figs.—*Taxus.* Trécul, A. Bull. Soc. Bot. i. 274. On secondary formations in the wood cells.—*Taxus*, *Torreya.* Mohl, H. v. Veget. Cell. 18—*Taxus*, *Araucaria*, *Salisburia.* Quekett. Histology, fig. 85.—Henfrey. A. Micr. Dict. 'Wood,' with figs.—Schacht, H. Die Pflanzenzelle, pp. 180, 195, 435. tabb. xii—xiv. A tabular review is given of the anatomical relations of the wood of several genera of Coniferæ, in respect to the form and arrangement of the liber-cells and layers, presence or absence of resin-canals in the bark or wood, definition of the annual zones, the dotting of the wood-cells and cells of the medullary rays, the form of the 'pore-canals,' &c. Lehrbuch, i. 229. Der Baum. 187, &c. *Pinus sylvestris.* pp. 180, 197, and tab. xii—xiv.—Dippel. Ueber die Entstehung und d. Bau der Tüpfel. Bot. Zeit. 1860, 329, with figs.—*Gnetum.* Voyage de la Coquille. Atlas Bot. 1826, i. 11, 12.—Richard. Nouv. Élémens de Botanique, 1846, 157.—Blume, Rumphia, iv. 1848, 9. tab. 176.—Jussieu, Ad. de., Monograph des Malpighiacées, p. 125.—Griffith, Notulæ, iv, 32.—Radlkofer, L. Ueber das anomale Wachsthum des Stammes bei Menispermeen. Flora, 1858, 206. The stem-structure differs from that of Menisperms only in that each zone (not the innermost only) of wood-bundles possesses its corresponding liber-layer.—*Welwitschia mirabilis.* A detailed account, with numerous figures of the wood-structure of this singular plant, by Dr. Hooker, will appear in the Linnean Trans. xxiv. part i. It is referred by him to Gnetaceae; the structure of the flower resembling, in many points, that of *Gnetum and Ephedra.* From the non-development of a distinct ascending axis, the arrangement of the woody-bundles is totally different from that of its allies, as is, also, the histological character of the tissues composing them. Apart from the form of the stock and general structure of the wood, which cannot be well explained without figures, the more remarkable features are, (1.) the isolation of the vascular bundles, consisting of barred vessels of small diameter and spirals, cambium-cells, and a remarkably large cord of liber; (2.) the presence, scattered through the parenchyma of almost the entire plant, of long, often irregularly branched, and very thick-walled cells, usually more or less covered with minute rhomboidal crystals, the composition of which is yet undetermined; (3.) the fine transverse barring of the very long bast fibres. The parenchyma forming the matrix traversed irregularly by the vascular bundles of the wood, is thin-walled and usually destitute of markings, excepting in the peduncle, cone-axis, and immediately around the vascular bundles of the leaf where it is strongly dotted or slit-marked. Disc-marked prosenchyma, characteristic of Coniferae, does not occur.* (D. O.)—*Ephedra.* Meyen, F. J. F. Phytotomie, 1830, tab. xiii. 9.—Mohl, H. v. Ueber den Bau der grossen getüpfelten Röhren von. Linnæa. 1831, 593, und taf. Ann. Sc. Nat. 1832, 29, 76. The wood-cells bear discs not only on the surfaces parallel to the medullary rays, but also towards the bark and pith; thus differing from *Pinus, Thuja, Juniperus, Cycas, and Zamia.* In the inner part of each annual ring lie wide porous tubes: these are not irregularly scattered through the wood, as Meyen states.—Meyen, F. J. F. Anat. und Phys. d. Gewächse. 1836, tab. vi. 1-8, 10, 11. Neues System Pflz.-Physiologie, 1837, i. 369, 379.—Schultz, C. H. Die Cyklose. Nova Acta Ac. Cæs. L. C. 1841, xviii. Suppl. ii. (fig.) and *Pinus*, (fig.) tab. iv.—*Casuarina.* Kieser. Mém. sur l'organisation des plantes, 1814, 306.—Goeppert, H. R. Bemerkungen über den anatomischen Bau der Casuarineen. Linnæa, 1841, 747. Ann. Sc. Nat. Ser. ii. 18, 1, with one pl. The species observed were *C. equisetifolia, C. stricta, C. torulosa,* and herbarium specimens of *C. glauca, C. paludosa, C. muricata, C. distyla,* and *C. 4-valvis.* The pith-cylinder is rarely more than 10-12 cells in diameter. Spiral vessels occur in its sheath. From the medulla proceed usually 20-25 principal rays (*rayons grands*) : *rayons petits* also occur in considerable number from each ligneous zone. Crossing the wood transversely from ray to ray are bands of cellular tissue similar in structure to the rays. These are distinguished as 'rayons medullaires concentriques ou connectifs,' in contradistinction to the usual rays, 'medullaires centrifuges.' The cells of prosenchyma are narrow, thick-walled, marked with a single series of dots. Dotted vessels are irregularly scattered through the wood. Annual wood zones are not apparent. In *Casuarina equisetifolia* the transverse bars of thin-walled cells between the medullary rays bear no relation to these rays.—*C. torulosa.* Sanio, C. Vergleichende untersuchungen über den Bau und die Entwickelung des Korkes. Pringsheim's Jahrb. ii.103, tab. xiii. On the structure and development of the cortical layers.*—Lindley, J. Veg. Kingdom, 250.—Henfrey, A. Microg. Dict. 'Wood.'

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* *Vide* N. H. R. iii. 201.

CYCADEAE. Moldenhauer, J. P. Beiträge z. Anatomie der Pflanzen, 1812, 111.—Treviranus. Vom inwendigen Bau der Gewächse, 1806, 130.—Link. Elementa Phil. Bot 73.—Brongniart, A. Recherches sur l'Organisation des tiges des Cycadées. Ann. Sc. Nat. 1829, xvi. 398, with 2 plates. An account of the Anatomy of *Cycas revoluta.* The stem presents a central parenchymatous pith, two concentric fibrous zones, separated by a narrow layer of parenchyma, and a thick cortical parenchyma, traversed by vascular bundles passing to the leaves. The fibrous zones are composed solely of greatly elongated, tapering, dotted cells. Dotted and spiral vessels are not found in the stem. Gum-canals occur in both the medullary and cortical parenchyma.—*Cycas* and *Zamia.* Buckland, W. On the *Cycadeoideae.* Geol. Trans. Ser. ii. ii. 46.—H. v. Mohl. Ueber den Bau des Cycadeen-Stammes und sein Verhältniss zu dem Stamme der Coniferen und Baum-farn. München Dkschrift. K. b. Ac. Wiss. x. (1832) Ext. pp. 46, with 3 pl. M. Mohl's observations upon *Cycas latifolia* and *C. revoluta* confirm the general analogy between the wood of Cycads and Conifers maintained by Brongniart; he points out, however, the inaccuracy of his statement that Cycadeae are destitute of vessels, that they possess the concentric wood-zones, of which the inner stands in no relation to the leaves, and that they are without liber. Pith occupies the greater portion of the stem. The wood consists of two immediately superimposed layers of nearly equal thickness, of which the inner is the wood-mass, the outer liber. The inner woody zone is closed and traversed by medullary rays; it consists of porous cells, which are regarded as belonging to the vascular system, because the author finds the spiral vessels gradually pass into slit-marked, and these into the dotted tubes which compose the wood of Cycadeae, without admixture of prosenchyma. The liber ring consists of short, truncate, superimposed cells. The parenchyma of the pith and bark is traversed by branching intercellular canals, filled with a colourless gum. The course of the vascular bundles is described in detail, and a comparison of Cycadeous structure with that of Palms and Tree-ferns (between which, in respect of anatomical relations, they are held to be intermediate), is entered into.—Corda. Ueb. d. Bau des Pflanzenstammes, in Weitenweber's Beiträge z. Natur- und Heilwiss. Prag. 1836, i. Hft. 23—*Zamia.* Link. H. F. Icones Anat. Bot. 1837, fasc. ii. xv. 1, 3.—Meyen,

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* In this paper the development of cork-tissue in the cortical layers of numerous species is described and illustrated by figures. I have not separately referred to them.

F. J. F. Neues system Pflz.-Physiologie, 1837, tab. iii. 6-8.—*Zamia integrifolia.* Brongniart, A. Obs. sur la Structure intérieure du *Sigillaria*, &c. Arch. du Muséum (1839) i. 425, tab. xxxiv. The wood-cylinder consists of narrow, irregular, radiating series of vessels, marked with transverse or reticulate bars, separated by medullary, parenchymatous plates.—Don, D. Linn. Soc. Proc. 1840, 53. No distinction of wood and liber in the vascular bundles. *Cycas* has a large central pith, and several thick, alternating layers of cellular and fibro-vascular tissue. In *Zamia* and *Encephalartos* there are but two very thick layers surrounding the pith, one fibro-vascular, the other and exterior, parenchymatous. The wood-mass consists of two kinds of vessels, viz., slender, transparent tubes, without dots, &c., and dotted, reticulated and spiral vessels, capable of unrolling: the former identical with the fibrous or woody tissue, the latter comparable to the strictly vascular tissue of other plants. The dotted 'vessels' of Cycads may have 1-2 to 5 rows of dots, not always confined to two vertical sides; in some cases seeming to follow the entire circumference of the vessel. No generic distinction can be drawn from the character of the vessels. The dots are always arranged obliquely. The cellular tissue of Cycadeae consists of tolerably uniform elements. All Cycads have numerous gummiferous canals, often of great length, and with thick walls. —Miquel, F. A. W. Monographia Cycadearum, 1842. Anatomical Structure, p. 3.—Bischoff. Lehrbuch ii. 61, 64,—Meyen, F. J. F. Neues Syst. Pfl. Physiol. tab. iii.—Morris, J. Remarks upon Recent and Fossil Cycadeae, Ann. Nat. Hist. vii. 110.—Miquel, F. A. W. Ueber den Bau eines gewachsenen Stammes von *Cycas circinalis*, 3 plates. Linnæa, 1844, 125. Ann. Sc. Nat. iii. Ser. 5, 11. Silliman's Journ. Sept. 1846. Four concentric belts are distinguishable in a transverse section of an old trunk. (1) Exterior and (2) interior cortical parenchym; (3) wood, formed of unequal, irregular layers (6-8 in an old stem), more or less interrupted by confounding with adjoining layers or dividing into two; these are separated by zones of cellular tissue: the cells of the wood are all dotted: and (4) pith.—Endlicher and Unger. Grundzüge d. Botanik, 92.—De Vriese, W. H. Descriptions et Figures des Plantes Nouvelles, &c. Leide, 1847. *C. circinalis* (with figs).—Griffith, Notulae, iv. 2.—*Zamia muricata.* H. Karsten. Organographische Betrachtung der. Abhandl. d. K. Ak. Wiss. Berlin, 1856, 193. Observations on the development of the ligneous zone, &c. Spirals and liber fibres are absent from the pith.—Schacht, H. Pflanzenzelle, 284. Scattered vascular bundles are found in the pith.—Henfrey, A. Micr. Dict. 'Wood' (fig.). The wood is composed of pitted prosenchyma, without vessels or ducts, except in the medullary sheath. Its zones are separated by alternating, parenchymatous layers.

RHIZANTHEAE. R. Brown, Linn. Trans. xix. 221.—Griffith, W. 303 (with figs).—Endlicher und Unger, Grundzüge d. Botanik, 92.—*Rafflesia*. Blume, Flora Javae. Rhizantheae, p. 9, with figs. On the Structure of *R. Patma*.—Vriese. W. H. de. Mémoire sur les *Rafflesias Rochussenii* et *Patma*. Leide, 1853, with 2 plates.—Unger, Frz. Beiträge z. Kenntniss d. Parasit. Pflanzen, 1841, tab. ii. 4.—*Brugmansia*. Blume, Flora Javae. Rhizantheae, p. 14, with figs.—*Balanophoreae*. Unger, F. Beiträge z. Kenntniss d. parasit. Gewächse. Ann. Wiener Mus. ii. 38. —Göppert, H. R. über den Bau der Balanophoren. Nova Acta Ac. Caes. L.C. 1841, xviii. Suppl. i. 229, with figs.—Göppert, H. R. Zur Kenntniss der Balanophoren, insbesondere der Gatt. *Rhopalocnemis*, Jungh. in Nova Acta. xxii. 1847, 117, with plates. —Griffith, W. Linn. Trans. xx. 96 (with figs).—J. D. Hooker. On the structure and affinities of *Balanophoreæ*. Linn. Trans. xxii. (Rhizome, p. 2.), with plates. The rhizome of the more perfect species is described as decidedly exogenous, possessing pith and vascular wedges, traversed by medullary rays. In some species the central tissue is formed of long 'wood-tubes.' Special modifications are described in the various genera.—*Cynomorium*. Weddell, H. A. Mémoire sur le. Arch. du Muséum, x. 269. Rhizome, p. 275, with figures.

ADDENDA.

POLYGALACEAE. *Epirhizanthes*. Chatin, G. A. Anat. Comp. d. Végétaux. Livr. 5. 132. The stem possesses a complete woody circle and a fibro-cortical system. Spiral vessels, absent in the rhizome, occur in the stem. There are no medullary rays.

CACTACEAE. *Opuntia*. Cauvet. Rec. Mém. de Méd. 3e Ser. v. 67.

CINCHONACEAE. Structure of the cortical layers of species of *Cinchona*. Howard. Illustrations of the Nueva Quinologia of Pavon: Supplt.

CAPRIFOLIACEAE. *Lonicera*. Baillon, H. Rec. d'Obs. Bot. vol. i. 376.

XXIII.—ON THE EXISTENCE OF TWO FORMS OF PELORIA. By Maxwell T. Masters, M.D., F.L.S., Lecturer on Botany, St. George's Hospital.

IN collecting materials to illustrate the nature of Peloria, I have been much struck with the fact of the existence of two varieties of this exception to the ordinary rule of floral structure, and the more so, as this duality is almost entirely unnoticed by systematic writers on this subject.

So far as I am aware, the only writer who has distinctly called attention to the two forms, is my much lamented teacher, Edward Forbes, who contrasts the two varieties, in a paper read before the Linnean Society, in June, 1848, upon Peloria as affecting certain specimens of *Viola canina*, gathered by himself in the Isle of Portland.

It is not my intention at this time to treat of the general subject of Peloria, but to confine myself to the illustration of the differences between the two forms of this deviation from the ordinary construction of the flower: nor shall I here cite many of the numerous figures and descriptions given by various authors, who have put such instances on record. A few illustrations will suffice to establish the fact, and these I prefer to select from my own experience, or from well-marked recent instances noted in various periodicals, reserving others for future more extended examination and discussion.

Modern botanists have considered Peloria as the effect of an accidental recurrence to the regular type, from which the irregular form is the habitual deviation, or to use the words of Moquin Tandon,* "Une fleur péloriée n'est autre chose qu'une fleur régularisée." The earliest discovered, and best known instance of this phenomenon, occurs in *Linaria vulgaris*, wherein, in place of a corolla with a single spur and a two-lipped limb, five spurs and a regularly five-lobed limb are met with.

In this case it is evident that the regularity results from the increase in number of the ordinarily irregular portions. It is indeed a "fleur régularisée"—a flower made regular.

Contrast with this, the double *Tropæolum*, now common in gardens: the single *Tropæolum* has a coloured calyx, provided with a long spur; in the double variety the calyx consists of five equal, green sepals. Here it is obvious, at a glance, that the regularity is not due, as in the *Linaria*, to an increase in the number of habitually irregular parts, but to a very different phenomenon, the entire absence of irregular parts. The parts of the flower, in the latter case, retain, throughout the whole of their existence, that regularity of outline and equality of proportion, which, according to the organogenic researches of Barnéoud and others, obtains *in initio* in all flowers, no matter how irregular they afterwards become. From this it follows, that the notion commonly accepted among botanists from the time of the elder De Candolle, that peloriated flowers are the consequence of an accidental return to the regular type, holds good, not to the class of flowers to which they have constantly applied it, but to that other class, as illustrated by the double *Tropæolum*, which they have almost entirely overlooked. Moquin† indeed refers the latter class of cases to a group consisting of "Irregular alterations of Form, or Deformities." Such a classification of flowers, which, although exceptional in regard to the frequency of their production, are not deformities, but exactly the reverse of deformities, viz. flowers, in which the primordial regularity of form is not departed from—is singularly inappropriate. Of the two, it would be more correct to include the original Linnæan Peloria under this group, than to place it, as Moquin does, under the head of "regular alterations of Form."

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* Élém. Tératol. Végét. p. 186.

† Op. cit. p. 162.

It is now too late, and it would lead to too much confusion, to change the application of the term Peloria, but it is evident, from what has been before said, that the definition previously given of Peloria, as an accidental return to the regular type, does not apply to the class of flowers to which it is given; while, on the other hand, it does apply with strict truth to a set of flowers, which by systematic writers are classed as deformities, or irregular alterations of form! As the word Peloria itself merely signifies something strange and out of the common way, there can be no objection, I think, to the introduction of the terms Regular and Irregular Peloria. "Regular or Congenital Peloria" would include those flowers which, contrary to their usual habit, retain throughout the whole of their growth their primordial regularity of form and equality of proportion. "Irregular or Acquired Peloria," on the other hand, would include those flowers in which the irregularity of growth that ordinarily characterizes some portions of the corolla is manifested in all of them. By way of illustration, I will now cite a few instances of both forms of Peloria, which will serve to explain the differences between them, better than any description could do.

Among the Aconites we occasionally find an increase in the number of irregular portions. Seringe* describes and figures a flower wherein all the sepals were helmet-shaped and all the petals presented that peculiar form, which, under ordinary circumstances, is assumed by two only, the other three being reduced to the condition of mere scales. On the other hand, in some garden varieties of Columbine, *Aquilegia*, the irregularity disappears almost entirely. So I have met with specimens of *Delphinium peregrinum* from Syria, in the herbarium of Sir Wm. Hooker, in which the flowers were quite regular and had never deviated from the regular form:—In these specimens the calyx consisted of five hairy sepals, within which were an equal number of stalked petals, with oblong laminæ, somewhat shorter than the stalks; the stamens and pistils presented nothing unusual.

In Violets both varieties of Peloria occur, that in which there are supernumerary spurs and that in which there are no spurs at all, as in the var. *anectaria*. In *Pelargonium*, the central flower of the truss frequently retains its regularity, so as to become like that of a *Geranium*. This change is, as Mr. Darwin remarks, accompanied by other changes, such as the loss of colour in the two upper petals, the absence of the nectary, &c.†

Among the *Papilionaceæ*, I have met with perfectly regular flowers in Lupins and *Cytisus Laburnum;* in these instances the petals have been equal in form and size and very generally increased in number from five to six.

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* Mus. Helvet. i. p. 132.

† Origin of Species, p. 145.

In *Lonicera* I have seen regular peloria occur, as well as a greater than ordinary amount of irregularity. The *Compositæ* afford instances of both kinds of Peloria: thus, it not unfrequently happens, that the ligulate florets of the ray become replaced by tubular florets, like those of the disc. I have met with numerous intermediate forms in many Composites, particularly in the *Chrysanthemum*, in some varieties of which, it is common to meet with ligulate, tubular and bilabiate florets, with numerous intermediate gradations in form, in the same head. In cultivated Dahlias the ordinarily tubular florets of the disc are to a greater or less extent replaced by ligulate florets, —irregular Peloria. In ligulate florets, however, the irregularity consists not so much in inequality of the size of the constituent petals as in the direction of the petals to one side. In *Digitalis*, *Pedicularis*, *Teucrium*, &c. Peloria from equality of development has been noticed, as well as the more frequent form that results from increased irregularity of growth. In *Linaria* itself it is not uncommon to meet with both varieties of Peloria; that in which five spurs are produced, and that in which no spurs at all are produced, as in the var. *anectaria.*[*]

I have already mentioned the fact that Moquin refers the last named instances to the category of Deformities. This is the more curious as in the same page he refers to the adventitious formation of spurs, from the palate or sinus of the upper lip of *Antirrhinum*, *Linaria*, *Digitalis*, &c. productions which in the present state of our knowledge cannot be otherwise considered than as Irregularities, and even quotes the words of Chavannes: " Qu'il ne faut pas confondre ces appendices avec les véritables éperons des Linaires, ils ne tiennent point comme ces derniers à la base des pétales mais dans des points plus ou moins rapprochés de leur sommet." He thus includes in the same group formations which are obviously irregular and formations that deviate from the ordinary rule in being less irregular than usual!

In *Halenia*, a genus wherein the corollas have usually five spurs, Sir Wm. Hooker figures and describes a species wholly or partially destitute of spurs, *H. heterantha.*[†]

Among the *Orchideæ*, flowers are occasionally met with in which there are a greater number of irregular portions than is customary,[‡] and on the other hand specimens now and then occur, in which the flowers lose to a greater or less extent their irregularity. I have seen such flowers in *Orchis pyramidalis* and *O. morio*, in *Cattleya Mossiæ*, etc. One species of *Dendrobium*, *D. normale*, derives its specific name from this circumstance. Dr. Lindley remarks, that in cultivation *Calanthe veratrifolia* occasionally produces regular flowers.*

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[*] Chavannes, Mon. Antirrhin. pp. 68, 69.

[†] Fl. Bor. Amer. t. 155, 156.

[‡] Greville, Fl. Edinens. p. 87. *Corallorhiza.* Curtis. Fl. Londin. t. 82. *Orchis tephrosanthos.* Clos. Mém. Acad. Imp. Sc. Toulous. Vol. 3. 5me Série, *Orchis*, etc. etc.

M. Gris has placed on record some interesting cases of regular Peloria, affecting the flowers of *Zingiber Zerumbet*.†

The two forms of Peloria, which I have thus attempted to illustrate, present many points of great interest for the systematic, no less than for the philosophic botanist. They afford many subjects for extended investigation, and give rise to much, not wholly unprofitable, speculation. It would be interesting to determine, if possible, the effect of relative position and other external circumstances in producing one or the other form of Peloria; to ascertain whether this dimorphism has any relation to increased or diminished fertility, or to any other functional changes; to discover which of the two forms is the more constant; which is to be referred to exaltation of, and which to degeneration from, the characteristics of an assumed type or possible progenitor; and to trace the numerous gradational forms existing between the two kinds in the same species, as well as those between distinct, or so-called distinct, genera and families.

Into these topics I must not now enter.

XXIV.—On the Fossil Estheriæ. By T. Rupert Jones, F.G.S., Professor of Geology and Mineralogy, Royal Military College, Sandhurst.

Geologists, looking at fossils as witnesses of the varied conditions of land and water in remote times, desire to inquire fully into the probable habits and relationship of every organic relic of the past. Fossil shells, forming the chief portion of the materials in the hands of the palæontologist, become especially the subject of such inquiries, and are made to yield evidence as to the relative age and the mode of formation of the several strata in which they occur. It is by comparing the extinct shells with those now living, and assuming for the fossil mollusc habits similar to those belonging to the most nearly allied of its existing congeners, that geologists for the most part form a judgment as to the character of many strata, whether they were marine or fluviatile in their origin, whether formed in shallow or in deep water. We are not surprised that the evidence thus obtained should often be weak and occasionally faulty, seeing that mere similarity in the form of shells has sometimes to be taken as evidence of generic relationship or of specific identity; whereas the soft parts of the mollusc, now lost, might have borne other evidence.[*] In nothing are naturalists so much deceived as by the manifold mimetic resemblances occurring throughout all kingdoms of nature. These are not wanting between different groups of the molluscs themselves,[†] and they are very striking in the case of certain Bivalved Crustaceans (forming the subject of this notice), closely resembling in general form some of the Molluscous Bivalves. A glance at a series of figures of the fossil *Estheriæ* reminds us of many well-known forms of Lamellibranchiata, such as *Posidonomya*, *Modiola*, *Myacites*, *Anodon*, *Unio*, *Cyclas*, *Pisidium*, *Kellia*, *Turtonia*, *Nucula*, and others; and indeed some of the species which I have to notice have been referred by palæontologists to *Posidonomya* and other molluscs. It has, however, generally been felt that there was a difficulty in the exact determination of these little shells; a rigorous examination of their form and structure was still wanting, the pocket-lens only, and not the microscope, having been brought to bear on them.

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* Gard. Chron. 1854, p. 804.

† Bull. Soc. Bot. Fr. Mai, 1859.

When subjected to the microscope, and drawn by means of the camera-lucida, many of these minute shells no longer appear with the outlines given to them by the old plates and woodcuts; thus *Estheria membranacea*, when perfectly portrayed, is no longer the triangular

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[*] A marked instance of palæontological uncertainty as to the relationships of certain bivalves occurs in the case of some of the "Rhætic" fossils, thus alluded to by Mr. Charles Moore, in the Quart. Jour. Geol. Soc. vol. xvii. p. 502, when describing them under the generic name "AXINUS, Sowerby:"—"Few shells have been subject to greater transposition, or have been placed under so many different genera, as those included in the group under notice. Von Credner, in Leonhard und Bronn's Jahrbuch, 1860, p. 307, remarks that one of the Rhætic species has by Roemer been called *Venus liassica*, but without a figure; by Quenstedt, in Der Jura, *Opis cloacinus*; that Escher notices it, but without naming it, from the Kössen beds; by Oppel and Suess it is called *Schizodus cloacinus*; and that it had previously been given by Bornemann, but without a figure, as *Tæniodon Ewaldi* of Dunker. In previous notices of the fossils from this zone, by Mr. Strickland, the Rev. P. B. Brodie, and also by Dr. Wright, reference is made to a shell called *Pullastra arenicola*, Strickl., which is said to occur very abundantly, but only in casts, and of which no figure has been given; there is no doubt it belongs to the group under consideration. They have also been included by other English authors under the genera of *Tellinites*, *Isocardia*, *Cucullæa*, *Donax*, *Sedgwickia*, and *Schizodus*. It is not clear wherein the following shells from Beer-Crowcombe differ from the *Axinus* of Sowerby; and his name, having priority, is therefore retained."

We must recollect, however, that we have in this case a set of dwarfed shells, probably of brackish-water habitat.

[†] In a memoir in the Philosophical Transactions for 1835, Dr. J. E. Gray treats of "shells having every appearance of belonging to the same natural genus, but inhabited by animals of a very different character" (p. 301); and, as examples, he enumerates—

Pupa and Vertigo.
Vitrina and Nanina.
Rissoa and Truncatella.
Siphonaria and Ancylus.
Littorina and Assiminia.
Mytilus and Dreissena.
Anodon and Iridina.
Cytherea and Artemis.
Cyclas and Pisidium.
Paludina and Littorina.
Littorina and Phasianella.
Neritina and Nerita.
Bullia and Terebra.
Aporrhais and Rostellaria.

"Cyclas" or "Venus" of older figures, but has a semi-orbicular Posidonomya-like form. On the other hand, *E. minuta* has more of the Pisidium-shape than its old name "Posidonomya" would indicate. The microscope, moreover, exhibits the peculiar superficial ornamentation so characteristic of the bivalved Crustacea, and wanting in the Mollusca; but of this ornamentation of the *Estheriæ* we had at hand the published illustrations and descriptions, by Dr. W. Baird, in the 'Zoological Society's Proceedings,' 1849, &c.; and by this author and other carcinologists the animals of *Estheria* and its allies, the *Limnadia* and *Limnetis*, had been already fully made known. Another important result of the application of the microscope to these once obscure organic remains was the determination of the intimate structure of the shell as belonging to crustacean and not to molluscan organisms. Whilst the shell of *Posidonomya Becheri* of the Lower Carboniferous rocks, and of *P. Bronni* of the Lias, is truly of the molluscan type,* that of the so-called *Posidonomya minuta* and its allies is crustacean.

One of the fossil *Estheriæ* (*E. tenella*, passing under the name of *Posidonomya*) was regarded by Agassiz, in 1845, and by Naumann, in 1848, as being related to *Cypris;* Dr. Volger, in 1846, suggested of another (*E. minuta*) that it might be a bivalved Crustacean; and another (*E. ovata*) was suggestively referred to *Cypris* and its allies by Lyell and Morris in 1847.

In 1856 the Rev. W. S. Symonds, F.G.S., favoured me with some well-preserved specimens of the little Triassic *Estheria*† from Pendock, Worcestshire; and with the late Prof. J. Quekett's kind assistance I was enabled to see, most distinctly, the true crustacean character of the texture of its valves under the microscope. This confirmed an opinion I had long held, and which had been previously advanced by Agassiz and Naumann,‡ by Volger§ and by Lyell and Morris,‖ that some of the little fossils known as *Posidonomyæ* are not molluscs, but closely allied to *Limnadia*, *Limnetis*, and *Estheria*, bivalved phyllopodous Crustaceans (*Entomostraca*) of the present day; and, indeed, as far as the carapace-valves are concerned, this and the other so-called *Posidonomyæ* referred to correspond to the *Estheria* of Rüppell and Baird[*] (*Isaura*, Joly; *Cyzicus*, Audouin).

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* Having the late Professor Quekett's authority in deciding the molluscan character of a shell of the Lower Carboniferous *Posidonomya* from Northumberland, which we examined together under the microscope, I cannot agree with Mr. J. W. Salter in thinking it probable that the great *Posidonomyæ* of the Carboniferous rocks are crustacean, as suggested in his paper in the Annals Nat. Hist. 3rd ser. 1860, vol. v. p. 153.

† This is the little Triassic shell that has been termed *Posidonia*, and *Posidonomya, minuta; Posidonia minuta* (Alberti), Goldfuss; *Posidonomya minuta*, Bronn, Zieten, Strickland, and others. In Morris's Catalogue of British Fossils, 2nd edit. 1854, it is included in the *Crustacea* (as *Estheria minuta*); but (apparently from inadvertence) it has not been expunged from the list of molluscs in that work.

‡ Bullet. Soc. Géol. France, 2nd ser. vol. v. p. 301, and vol. vi. p. 90.

§ Neues Jahrbuch f. Min. 1846, p. 818.

‖ Quart. Jour. Geol. Soc. vol. iii. p. 275, and Lyell's Manual of Geology, 5th edit. p. 332.

Different species of these fossil *Estheriæ* occur in the Devonian rocks (Caithness, Orkney, Livonia, and Russia); Carboniferous (Scotland, Berwickshire, Lancashire, Derbyshire, Belgium, France, Bavaria, and Silesia); Permian (Ireland, Saxony, and Russia); Triassic (England, France, and Germany); Rhætic (Somerset, Gloucestershire, Warwickshire, Worcestershire, and Elgin); Oolitic (Skye and Scarborough); and Wealden (Sussex and Hanover). Others are met with in the coal-fields of Lower Mesozoic age, in North and South Carolina and Virginia, and along their north-western extension, forming the so-called "New Red Sandstone" of Pennsylvania;[†] and in the plant-bearing sandstones of India (Mángali, Panchét, and Kotá); and in beds of undetermined age in Siberia (Tertiary?) and South America (Mesozoic?).

Although occurring so constantly in the different geological periods, from the Devonian to the Wealden,[‡] and again in some Tertiary beds and in the recent fresh waters, yet it is in the Rhætic and Triassic deposits of Britain and the Continent, in the carbonaceous shales of Pennsylvania, Virginia, and the Carolinas, and in the plant-bearing beds of India, that this little Bivalved Entomostracan appears to be pre-eminently abundant, so as to serve probably as a faithful index of a peculiar geological horizon.[§]

In like manner, among the still lower forms of life, the Nummulite is represented in the Carboniferous, Liassic, Oolitic, and Cretaceous rocks, and exists also at the present day; but it particularly distinguished one epoch (the Tertiary) by a surprising fecundity and a temporary profusion of individuals.

The occurrence of a fossil *Estheria* in the Upper Sandstone and Shale of the Scarborough district (*E. concentrica*, Bean,[‖] sp.) is of considerable interest, as indicative of the association of this crustacean genus with the Jurassic flora in England, as it is with a somewhat similar flora in India and North America.

In India a Labyrinthodont reptile (*Brachiops laticeps*)[¶] is found in the same strata as yield *Estheria* at Mangali, possibly contemporaneous, or nearly so, with those containing plants at Nagpur; near Panchét also, in north-eastern India, *Estheria* occurs in equivalent beds, with Dicynodont and Labyrinthodont remains;* and in Pennsylvania, with reptilian remains† *Estheria* abounds." In North America, indeed, the evidence seems to point to a contemporaneity of the coal- and plant-beds of Carolina and Virginia, the shales and sandstones of Pennsylvania and New Jersey, the foot-marked sandstones of Connecticut, and the Upper Red Sandstone of Nova Scotia and Prince Edward's Island, which is also reptiliferous;‡ and it is evident that in the Virginian and Pennsylvanian shales the minute crustaceans under notice are important fossils. The fossil plants of Nagpur and Bengal and of Virginia and the Carolinas having a Jurassic facies, much like those of the Venetian Alps and Scarborough, it will be interesting, as further evidences turn up, to see how far we are to regard the Triassic or the Jurassic element as preponderating, or whether a passage-group of deposits ("Rhætic") are indicated by the evidence; or, lastly, whether these Plant-beds with Reptiles and Crustaceans indicate the terrestrial and lacustrine conditions only of the early Mesozoic (Triassic) period.

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[*] Proc. Zool. Soc. part 17, 1849, p. 87.

[†] Continuous with the sandstones of New Jersey, and most probably with those of Connecticut also.

[‡] I have no satisfactory evidence of the presence of the genus in question in the Cretaceous deposits, excepting in their freshwater "Wealden" equivalent.

[§] Prof. W. B. Rogers has already pointed out (Boston Nat. Hist. Soc. Proc. v. p. 15, &c.) the probable value of this little fossil in the comparison of the Mesozoic rocks of North Carolina and Virginia, and of these with the so-called Triassic beds of the United States.

[‖] Mag. Nat. Hist. vol. ix. p. 376.

[¶] Quart. Journ. Geol. Soc. vol. ix. pp. 37 and 371.

The Jurassic-like flora of Australia§ and that of southern Africa have not hitherto afforded any clear traces of *Estheria*. The latter country, however, has its probably Triassic reptiles, the *Dicynodon* and its many associates, embedded with its flora;‖ so that the peculiar association above indicated for India and North America obtains there also.

In pointing out these facts in the geological and geographical distribution of the fossil *Estheriæ*, I merely touch upon the salient points of an interesting subject of research, for the elucidation of which careful inquiry at home and abroad is still requisite.

The known living species of *Estheria* are—

ESTHERIA GIGAS, *Hermann*, sp. Baird, Proc. Zool. Soc, 1849, p. 87, (= *Cyzicus Bravaisii*, Audouin, Annal. Soc. Entom. vi. Bullet. p. IX. 1837; *Isaura cycladoides*, Joly, Annal. Science Nat. 2 sér. 1842, xvii. p. 293. pl. 7, 8, and 9 A (figs. 1—45); *Estheria cycladoides*, Lucas, Explor. Scientif. Algérie, Crustacés, 81, 1845.)	Freshwater pools, Strasburg *(Hermann)*; brackish marsh, Arzeu, near Oran, Africa *(Bravais)*; ditch filled with rain-water (in June), Toulouse *(Joly)*; Tunis *(Frazer)*; Algeria *(Lucas)*.

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* Quart. Journ. Geol. Soc. vol. xvii. p. 362; and Mem. Geol. Surv. India, vol. iii. part 1, p. 1.

† Lea on *Clepsysaurus Pennsylvanicus*, Journ. Acad. N. Sc. Philad. n. s. vol. ii. p. 185; and on *Centemodon sulcatus*, Proc. Acad. N. Sc. Philad. n. s. vol. ii. p. 377.

‡ Leidy on *Bathygnathus borealis*, Journ. Acad. N. Sc. Philad. n. s. vol. ii. p. 327.

§ See M'Coy's paper, Ann. and Mag. Nat. Hist.. vol. xx, p. 145, &c.; and the Rev. W. B. Clarke's, Quart. Journ. Geol. Soc., vol. xvii. p. 354. Labyrinthodont reptiles have not been wanting in Australia; see Professor Huxley's description of *Bothriceps Australis*, Quart. Journ. Geol. Soc., vol. xv. p. 647.

‖ *Glossopteris*, &c.; Quart. Journ. Geol. Soc., vol. xvii. p. 329.

Estheria Dahalacensis, *Straus-Durckheim.* Mus. Senckenb., ii. p. 119. pl. 7, fig. 1—16; Baird, Proc. Zool. Soc. 1842, p. 82, Annulos. pl. 27, figs. 2—4.	Freshwater marshes of the Island of Dahalac, on the coast of Abyssinia, in December (*Rüppell*); and in stagnant water, on the banks of the Tigris, near Bagdad (*W. K. Loftus*).
— Melitensis, *Baird.* Proc. Zool. Soc., 1849, p. 88, Annulos. pl. 11, fig. 2.	Rain-water pool, Malta (*Hennah*); Sicily (*Cuming*).
— polita, *Baird.* Ib., fig. 3.	India (interior, N. E), *Boys.*
— Brasiliensis, *Baird.* Ib. p. 89, pl. 11, fig. 4.	Brazil (*Sowerby*).
— donaciformis, *Baird.* Ib., fig. 5.	Abeyd (White Nile), Kordofan (*Parreyss*).
— Boysii, *Baird.* Ib., fig. 6.	India (interior, N. E.), *Boys.*
— similis, *Baird.* Ib., fig. 7.	India (interior, N. E.), *Boys.*
— tetracera, *Krynicki*, sp. Bullet. Soc. Imp. Nat. Moscou, ii. 1830, p. 176, pl. 7, fig. 1; Baird, Proc. Zool. Soc., 1849, p. 90.	Freshwater marsh (in May), near Charkow, Russia, and at and near Moscow (*Krynicki, Fischer, and de Laveau*, 1817—29).
— Dallasii, *Baird.* Proc. Zool. Soc., 1852, p. 30, Annulos. pl. 23, fig. 5.	Brazil (?) *Dallas.*
— Hislopi, *Baird.* Proc Zool. Soc., 1853, p. 232, Ann. pl. 63, fig. 1.	Freshwater stream, near Nagpur, central India (*Hislop*).
— compressa, *Baird.* Proc. Zool. 1860, p. 188, Ann. pl. 71, fig. 6.	Freshwater pools, Nagpur (*Hislop*).
— Birchii, *Baird.* Ibid., p. 392, Annulos. pl. 72, fig. 1.	Pools of freshwater, on the banks of the Wamoi River, Australia (*Birch*).
— Gihoni, *Baird.* Ann. Mag. Nat. Hist., 3rd ser., vol. iv. 1859, p. 281, pl. 5, fig. 1.	Freshwater pool of Gihon, Jerusalem. *E. Gihoni* was reared in England, by Mr. H. Denny and Dr. Baird, from the dry mud brought from the Pool of Gihon.
— Hierosolymitana, *Fischer.* Abhandl. k. bayer. Akad. Wiss. München., viii. 1860, p. 649, pl. 20, figs. 7, 8. [? *E. Gihoni.*]	Rain-water pools on limestone, near Jerusalem, dry for ten or eleven months in the year (*J. R. Roth*).
— Australis, *Lovén.* Öfvers. af K. Vet. Förh., Årg. 3, 1846 (Stockholm, 1847), p. 57.	Freshwater marshes, Natal (*J. Wahlberg*).
— Dunkeri, *Baird,* Proc. Zool. Soc. 1862, p. 147, pl. 15, fig. 6.	Zimapan, in the neighbourhood of Mexico, where it lives with *Planorbis nitens*, Ph., *Limnæus subulatus*, De Kr., *Physæ*, and other molluscs, in stagnant waters (*Dunker*, Nordd. Wealdenbild., 1856, p. 61).
— Jonesi, *Baird.* Ib. fig. 1.	Brackish water, Cuba (*Dr. Dunker*).
— Loftusi, *Baird.* Ib. fig. 2.	Stagnant water, on the banks of the Tigris, near Bagdad (*W. K. Loftus*).
— Caldwelli, *Baird.* Ib. p. 148, pl. 15, fig. 4.	Lake Winnipeg (*W. Caldwell*).
— Rubidgei, *Baird.* Ib. fig. 3.	From the bed of a dried-up "vley" near Port Elizabeth, South Africa (*R. N. Rubidge*).
— Macgillivrayi, *Baird.* Ib. fig. 5.	Brackish lake at Green Point, Cape of Good Hope (*J. McGillivray*).

The closely allied genera *Limnadia* and *Limnetis* are known by the following species:

Limnadia Hermanni, *Ad. Brongn.* Baird, Proceed. Zool. Soc., 1849, p. 86, Annulos. pl. 21, fig. 1.	Freshwater pool, Fontainebleau (*Brongniart*).
— Mauritiana, *F. E. Guérin.* Magas. de Zool, Sept. Année, Class VII. p. 1—7, pl. 22 (21 in the text) figs. 1—11, 1837; Baird, Proc. Zool. Soc., 1849, p. 87.	Mauritius (*Julien Desjardins*).
— Antillarum, *Baird.* Proc. Zool. Soc., 1852, p. 30, Annulos. pl. 23, fig. 1.	San Domingo (*Sallé*).
— coriacea, *Haldemann.* Proc. Philad. Acad., 1842, vol. i. p. 184; and 1854, vol. vii. p. 34.	(Probably the same). "In ditches along the Susquehanna, in quiet water;" in "roadside ditches" (*S. S. Haldemann*).
Limnadella Kitei, *Girard.* Ibid., 1854, vol. vii. p. 3.	In fresh water, Cincinnati (*T. Kite*).
Limnetis brachyurus, *Müller.* Entomost., p. 69, t. 8. figs. 1—12.	Freshwater marshes, Denmark (*Müller*).
— Wahlbergii, *Lovén.* Öfvers. k. Vet. Akad. Förh., Årg. 3. No. 2, p. 57, 1847.	Freshwater marshes, Natal (*J. Wahlberg*).
— Gouldii, *Baird.* Proc. Zool. Soc. 1862, p. 149, pl. 15, fig. 7.	Freshwater, at St. Ann's, twenty miles from Montreal (*C. Gould*).*

The recent *Estheriæ* are found in fresh water; rarely in brackish water. Guided by this fact, and taking for granted that our fossils were true *Estheriæ*, and that *Estheriæ* always have had freshwater habitats, we should suppose that the deposits in which these fossils are found, free from any appearance of having been drifted, must have been formed in rivers, lakes, or lagoons. Applying, however, the same rules in judging of the nature of the fossil molluscs and other organic remains that occasionally accompany some of these *Estheriæ*, we must regard the *Lingula* of the Old Red (of Livonia), the *Spirorbis*, the *Aviculæ*, the *Anthracosiæ*, and *Anthracomyæ*† of the Carboniferous shales, and the *Lingula* and *Pleurophorus* of the Trias, as truly marine shells. Many, however, of our fossil *Estheriæ* occur in strata destitute of any such evidence of marine conditions; and possibly the occasional mixture of the marine and freshwater organisms may have been the result of drifting (the free-swimming *Estheriæ* being readily swept away by a flood), or of very rapid changes of condition, such as might be brought about by the alternate occupation of a lagoon by sea- and river-water.‡ Seeing, too, that the recent *Estheriæ* appear, as it were, suddenly (like the *Apus*) in pools and ditches of rain-water, and are quickly developed in tanks and ponds dry for even ten or eleven months in the year, it is not unlikely that pools of fresh water, temporarily formed on a flat sea-shore, may have been inhabited by *Estheriæ*, destined to be quickly buried in the first wind-drift of sand, or at the return of high tides. As an inhabitant of brackish water, the *Estheriæ* would be still more likely to have been occasionally accompanied by marine shells: nor can we say that the fossil associates quoted above were not inhabitants of brackish water, or of salt lakes; for experience is the only guide to the naturalist in determining whether the members of many of the molluscan groups affect marine, brackish, or freshwater habitats.

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* Dr. Baird has kindly assisted me in drawing up this table of the recent *Estheriæ* and their allies.

† According to Mr. Salter, 'Mem. Geol. Survey, 1861, Iron-ores of South Wales,' &c.

‡ See Sir C. Lyell's observations on the value of *Spirorbis* (in the fossil state), and barnacles (recent) in certain cases, as evidences of the occasional inroad of salt water into swamps, killing the marsh-plants and leaving behind such shells as the

Perhaps some might like to think that at first marine conditions alone suited aquatic animals, and that some have subsequently taken to brackish and freshwater habitats; and this may have been the case with *Estheria:* but, except for the "progressive" aspect of the argument, the converse might just as well hold good for the *Lingula*,* *Spirorbis*, *Avicula*, *Anthracosia*, *Anthracomya*, and *Pleurophorus*, mentioned as being found in the older rocks in company with *Estheria.*

Of the living molluscan genera that are known to have fluviatile as well as marine species, the following are the most prominent:—*Rissoa* (*Assiminia*), *Cerithium* (*Potamides*), *Arca* (*Scaphula*), *Solecurtus* (*Novaculina*), *Mytilus* (*Dreissena*), and *Cardium*,† but how the

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above, as well as *Modiolæ*, &c. ('Notices of the Royal Institution of Great Britain,' vol. i. p. 285.)

* *Lingula tenuissima* of the Trias bears evidence of its having been subjected to the gradually increasing influence of some deteriorating agency, probably fresh water; for in the several strata, from the Muschelkalk upwards, in Würtemberg, &c., *Lingulæ* are found to become smaller and smaller until *Estheria minuta* comes in.

† In Dr. J. E. Gray's "Memoir on Testaceous Mulluscs," in the Philos. Transact. for 1835, he treats of "Species of Testaceous Mollusca living in very different situations from the majority of the known species of the genus to which they belong, or having the faculty of maintaining their existence in several different situations;" and he illustrates the case (1st) of species of the same genus being found in more than one situation, as on land, and in fresh and in salt water, by *Auricula* (including *Conovulus* and *Chilina*); (2nd) of one or more speeies of a genus most of whose species inhabit fresh water being found in salt or brackish water, by *Limnæa*, *Neritina*, *Melania*, and *Melanopsis;* (3rd) of one or more species of a genus whose species usually inhabit the sea being found in fresh or brackish water, by—

Aplysia,
Cerithium,
Bulla,
Littorina (*Lithoglyphus*),
Solen (*Novaculina*),
Tellina,
Avicula,
Mya,
Corbula,
Ostrea (?),
Cucullæa (*Scapula*),
Neritina (*Theodoxus*),
Ampullaria (?), and
Cardium.

M. Beudant found by experiment (1803—1816), that many freshwater molluscs can be made by degrees to live in water gradually salted to the ordinary saltness of the sea; and that many marine molluscs can also, by gradually diminishing the saltness of the water, be accustomed to live in fresh water. See 'Comptes Rendus,' May 13th, 1816; 'Annales des Mines,' 1816, vol. i. p. 397, and De la Beche's 'Selection of Geological Memoirs,' 1824, p. 36.

extinct genera were circumstanced in this respect, and whether the old species of extant genera had similar habitats to those of their existing congeners, can only be partially surmised, chiefly from the evidence of the best known of their associates.

There are some existing genera the species of which appear to be essentially fluviatile, but live also in company with true marine shells in the mouths of rivers; these are *Cyrena* and *Ampullaria*. Such, too, may have been the habit of the old *Estheriæ*: at all events, there is no necessity for supposing them to have been marine; but where they occur by themselves, or in the company only of fishes* and plants,† they may be regarded as having lived and died in fresh (or possibly brackish) water. Where they are mixed with shells of presumed marine character, they indicate probably either that they inhabited brackish lakes, with a quasi-marine fauna (such as that of the Caspian Sea), or that fresh water was in close proximity to the place of deposit, if indeed it had not been replaced by the sea by, possibly, frequent alternations.

We must not forget, however, that, judging by analogy, the Entomostracous Crustaceans under notice may have been capable of living, at least for considerable periods, in even salt water, for some of the common *Cyprides*, such as are abundant in freshwater streams, are not uncommon in ditches of brackish and even highly saline water in the low grounds near the sea.

The following Table shows the distribution of the fossil *Estheriæ* and *Leaiæ*;‡ and indicates the organic remains found with them:—

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* With some exceptions, it is impossible to say of any fossil fish that it did, or that it did not, belong exclusively to the sea, even when it is occasionally associated with marine fossils, as some of the Old Red fishes are in Russia. Many genera of fishes are as capricious, as to the habitats of their species, as the above-quoted molluscs are. Nor must we forget that the stony-scaled and plated fishes of Palæozoic times are now best represented by the Bichirs and the Sheat-fishes of existing rivers (Huxley; 'Mem. Geol. Surv.,' 1861).

† The association of remains of land-plants with *Estheriæ* is not unfrequent. The occurrence of Bivalved Entomostracans with fish-remains is frequent in the fossil state, and agrees with the known habits of these animals. *Entomostraca*, like other *Crustacea*, act as scavengers among dead molluscs and fishes; and to many fishes they are an important article of food.

‡ *Leaia* is a problematical ally of *Estheria;* the *Cypricardia Leidyi*, Lea, is the only form of it hitherto published. It belongs to the Carboniferous Period.

GENUS AND SPECIES.‡	LOCALITY.	GEOLOGICAL STAGE.	ASSOCIATED ORGANIC REMAINS.
Estheria membranacea, *Pacht*, sp.	Livonia	Old Red	Lingula. Fishes.
	Caithness	Old Red	Fishes.
E. striata, *Münster*, sp.	Bavaria; Belgium	Lower Carboniferous	
E striata, var. Tateana	Berwickshire	Lower Carboniferous	Spirorbis. Fishes. Plants. Cypridæ.
E. striata, var. Beinertiana	Silesia	Lower Coal-measures	
	Lancashire	Lower Coal-measures	Spirorbis. Cypridæ.
	Lanarkshire	Lower Coal-measures	
E. striata, var. Binneyana	Derbyshire	Lower Coal-measures	
E. striata, var. Beinertiana	Lancashire	Middle Coal-measures	Fishes.
Leaia Leidyi, *Lea*, sp.	Pennsylvania	Lower Carboniferous	Plants.
L. Leidyi, var. Salteriana.	Fifeshire	Lower Carboniferous	
L. Leidyi, var. Williamsoniana.	Lancashire	Upper Coal-measures	Anthracosia.* Plants.*
Estheria tenella, *Jordan*, sp.	Schwarzwald	Upper Carboniferous or Permian	Crustacea* (*Gampsonyx*). Fishes* and Plants.*
	France (Autun)		
	Lancashire	Upper Coal-measures	Beyrichia.
	Lanarkshire	Upper Coal-measures	Spirorbis. Anthracosia. Avicula.
	Saxony	Lower Permian	Fishes and Plants.
E. exigua, *Eichw.* sp.	Russia	Permian	Beyrichia. Plants.*
E. Portlockii	Ireland	Permian	Fishes.*
E. minuta, *Alberti*, sp.	France	Bunter	Limulites.* Apus. Plants.*
	Hanover	Bunter	
	Germany	Lettenkohle	Lingula. Pleurophorus. Lignite.
	Hanover	Keuper	
	Worcestershire	Keuper	Fishes* and Plants.*
	Warwickshire	Keuper	Fishes.*
	Somersetshire	Keuper	
E. minuta, var. Brodieana	Gloucestershire	Rhætic	Plants.
	Somersetshire	Rhætic	Cardium (?). Plants. Insects.
	Morayshire	Rhætic	Cypridæ. Reptiles.* Fishes.* Plants.*
E. Mangaliensis	India	Rhætic or Triassic	Reptiles,* Fishes,* and Plants.
E. Kotahensis	India	Jurassic or Rhætic	Cypridæ, Fishes,* Plants, and Insects.*
E. ovata, *Lea*, sp.	North America	Rhætic or Triassic	Cypridæ, Fishes,* Plants,* & Reptiles.
E. Murchisoniæ	Skye	Oolite	
E. concentrica, *Bean*, sp.	Yorkshire	Oolite	Plants (Ferns and Cycads).
E. elliptica, *Dunker*	Germany	Wealden	Cyrena. Cypridæ. Plants.*
E. elliptica, var. subquadrata.	Sussex	Wealden	
E. Forbesii	South America	Mesozoic ?	Ferns.
E. Middendorfii	Siberia	Tertiary ?	Fishes (*Aspius*). *Limnæus* (?). Plants. Insects.

Marked thus * not in the same seam, but in closely associated beds.

‡ These species are described in full in my Monograph on Fossil Estheriæ, published by the Palæontographical Society.

To show the place of *Estheria* in the Crustacean group, Mr. J. D. Dana's classification* is here produced.

CLASS.—CRUSTACEA.

SUBCLASS I. DECAPODA. II. TETRADECAPODA. III. ENTOMOSTRACA.
Subclass—ENTOMOSTRACA.
  Ordo I. Gnathostomata.
    Legion I. Lophyropoda.
      Tribus I. Cyclopoidea.
        Fam. I. Calamidæ. II. Cyclopoidæ. III. Corycœidæ.
      Tribus II. Daphnioidea.
        Fam. I. Penilidæ. II. Daphnidæ. III. Polyphemidæ.
      Tribus III. Cyproidea.
        Fam. I. Cypridæ
          Subfam. I. Cyprinæ (*Cypris*, *Candona*).
            II. Cytherinæ (*Cythere*).
        Fam. II. Halocypridæ.
          Subfam. I. Cypridininæ. II. Halocyprinæ.
    Legion II. Phyllopoda.
      Tribus I. Artemioidea.
        Fam. I. Artemiadæ. II. Nebaliadæ.
      Tribus II. Apodoidea.
        Fam. Apodidæ (*Apus*).
      Tribus III. Limnadioidea.
        Fam. Limnadidæ.†
          Genus 1. Limnadia, *Ad. Brongniart.*
            2. Cyzicus, *Audouin.* [*Estheria*, Rüppell.]
            3. Limnetis, *Lovén* (*Hedessa*, Lievin).
  Ordo II. Cormostomata.
      Subordo I. Pœcilopoda. II. Pycnogonoidea (vel Arachnopoda).

Limnadia has the following diagnosis:—"Caput vix rostriforme, dorso tuberculum pyriforme gerens Pedes toti foliacei. Abdomen extremitate appendicibus acuminatis quatuor armatum."

Cyzicus.‡ [*Estheria*, Rüppell and Straus-Durckheim.] "Caput

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* "Report on Crustacea of the United States' Exploring Expedition," 1853, pp. 1277, &c.

† *Apusiens* (in part) of Milne-Edwards, Hist. Nat. Crust., iii. p. 513. The *Leperditidæ* (including *Leperditia*, *Beyrichia*, *Kirkbya*, *&c.*) form, I believe, a closely related (extinct) Family.

‡ Audouin, Ann. de la Soc. Entom., vol. vi. Bullet., Feb. 1837, p. ix; *Estheria*, Rüppell and Straus-Durckheim, Mus. Senckenberg, ii. 119, 1837; *Isaura*, Joly, Ann. Sc. Nat., 2 ser. xvii. p. 293, 1842.

Dr. Baird has the following observations on the generic name of this animal: "This genus was indicated by Audouin and Straus-Durckheim in the same year; the former proposing, for the species brought by M. Bravais from Oran, the name of *Cyzicus*; and the latter, for that brought by Dr. Rüppell from Abyssinia, the generic name *Estheria*. From the simultaneous publication of these two generic names, it is difficult to decide which should stand; and M. Joly, apparently feeling the difficulty, has proposed a third name, taking as the type the species found by him at Toulouse, and calling it *Isaura*. As M. Audouin merely indicates the genus, without giving a description of either genus or species, whilst M. Straus details at full length both generic and specific characters, and figures the typical species, I propose adopting his name, and retaining the generic name *Estheria*, a name originally proposed by Dr. Rüppell himself."

I coincide with Dr. Baird's opinion as to the propriety of using the term *Esthe-*

instar rostri productum, dorso non tuberculifero. Pedum paria numero fermé 21, foliaceorum. Abdomen ferè ac in Limnadiâ."

Limnetis. " Antennæ internæ 2-articulatæ. Cauda brevis, truncata, appendicibus facie inferiore destituta. Pedum paria 12."

The above-quoted diagnoses relate to the bodies and limbs of the three genera. In their carapaces they differ to some extent; *Limnetis* and *Limnadia* having a less perfect hinge and little or no umbo, and being generally destitute of concentric ridges; whilst in *Estheria* the carapace-valves have a definite hinge-line, well-marked umbones, and usually numerous distinct concentric ridges (boundary-lines of the periodic stages of growth of the carapace-valves). A reticulate sculpture ornaments the carapaces of the three genera; but in *Estheria* this ornamentation is stronger, and often modified by short vertical and inosculating bars.

The valves of *Estheria* are inequilateral, usually subtriangular or subovate; the umbo being almost always near the anterior end, and the edge of the valve and the parallel concentric ridges having a bolder curve posteriorly than in front. Occasionally, however, the umbo is almost central and the two ends of the valve nearly equal; the ventral edge of the valve and the concentric ridges having a nearly semicircular curvature. There are, however, numerous gradations of form between these extremes; so that I cannot see any grounds for a generic distinction being made between the subtriangular and the suborbicular forms on account of the relative position of the umbo.*

In three instances I find shortened or subquadrate forms of carapaces accompanying others of subovate outline (*E. striata*, *E. Mangaliensis*, and *E. elliptica*). This difference of shape may be sexual, or due to conditions of growth. Dr. S. Fischer assigns a shorter carapace to the female of his *E. Hierosolymitana*† than the one belonging to the male. The squarer carapaces above referred to are rare among the subovate individuals; some of the latter certainly contain what appear to be ova.

Of *Isaura cycladoides* (*Estheria gigas*) M. Joly has remarked that in its young state it undergoes certain successive changes of form, more or less analogous to the persistent conditions of "*Artemia,*

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ria; and the more readily, because, as I have elsewhere stated, I believe that in the case of appellations invented for *groups* of animals, plants, or minerals, whether they be names of genera, families, orders, or classes, it is not always priority that should determine the general use of such terms, but, either their adaptability, the preciseness of their definition, or other advantageous characteristics, as the case may be. With "specific" names, however, it is very different; the published name of a species is (or ought to be) not only the established appellation of a distinct form in nature, but also the registered evidence of the successful labour and acumen of its discoverer and describer.

* Dr Pander has informed me that he considers *Asmusia*, of Pacht, to be generically distinct from *Estheria* on this ground.

† Abhandl. Akad. Wiss. München, viii. pl. 20, fig. 8.

Branchipus, *Apus*, *Daphnia*, *Lynceus*, *Cypris*, *Limnadia*, and *Cyzicus*;" one of these stages being marked by the presence of a horizontal Apus-like carapace, and others being accompanied by varied outlines of the carapace-valves. These observations should make us very careful in the examination of the different forms of carapaces, especially those found associated in the same set of strata, and prepare us for the possible specific identity of dissimilar carapaces.

Recent *Estheriæ* have sometimes so thin a carapace that the valves curl up when dry, like horn-shavings or flakes of quill. In other cases, however, the valves are stout enough to retain their convex oviform shape when dry. The fossil *Estheriæ*, also, seem to have varied in this respect.

In the fossil *Estheriæ* we sometimes find more variety of ornamentation on one and the same valve than has usually been observed in single recent specimens. Possibly, however, a closer examination of the recent carapaces might in nearly all cases show similar series of modified sculpture on individual specimens.

About twenty species of *Estheria* are known to occur in the recent state, and six or seven of the two allied genera *Limnadia* and *Limnetis*. (See pp. 267, 268.) These are distinguished respectively either by differences in the form and ornament of the carapace, or by more or less important modifications of the limbs or other organs. Our characterization of the fossil *Estheriæ* must necessarily be independent of structural differences in the body itself; and it is therefore possible that the limited number of species indicated as fossil, and distributed by one and two through the several great accepted geological formations, might be somewhat enlarged if we set a high value on every recognizable difference in the outline and ornamentation of the valves. I have been careful, on the contrary, to restrict myself as far as possible in setting much value on slight modifications in the fossil *Estheriæ*.

When the umbo of the carapace-valve is near the anterior end, as is most frequently the case, we have a resemblance to some of the subtriangular and subovate Bivalve Molluscs, such as *Pisidium*, *Tellina*, &c.; when the umbo is more nearly central, there is sometimes a resemblance to an *Avicula* or a *Posidonomya*; and this likeness may be strengthened by the valves of the little *Estheria* being often wrinkled concentrically, the sharp ridges and neat interspaces being replaced by numerous convex ridges, and nearly all the original structure lost. Still a trace of the peculiar reticulate ornamentation is usually left; and the superinduced wrinkles are not so evenly convex as is usual in the *Aviculidæ*, nor so uniformly marked with parallel concentric striæ as is frequently the case with those shells. The valves are rarely so quadrate as in the *Posidonomya* and *Inoceramus*; and neither the wrinkles nor the ridges (whichever may mark the valves of the *Estheria*) are bent off away from the umbo to follow the outline of the produced ears of the shell present in most of the *Aviculidæ*, but absent in *Estheria*. Nor is there any trace of furrows or teeth on the hinge in *Estheria*.

A general crumpling of the shell of a very thin *Avicula* or *Posidonomya* irregularly corrugates the whole surface, concentric wrinkles and all; but in *Estheria* the true ridges are seldom thus interfered with, but rather yield to the transverse pressure by taking on an obliquity of direction, leaving the sculptured interspaces to show the crumpling effect of pressure. Rarely converted into calcareous matter, the Estherian carapaces usually present a delicate, brownish, horn-like tissue, generally with some degree of transparency and polish, contrasting with the dull and perfectly calcified shells of the *Aviculidæ*, or their bold wide-ridged impressions, black and filmy, or delicately nacreous. In carbonaceous deposits the *Estheriæ* often leave only black films or merely impressions. In one case a white siliceous (?) substance is found to replace the valves in a lignite (Lettenkohle). Sometimes a ferruginous film has replaced the carapace-valves, especially in sandstone.

As *Estheria minuta* has been referred to *Posidonomya* so generally and for so long a time, it is highly probable that other little fossils of the same class still pass as *Aviculidæ* in palæontographical works and in collections.* That attention might be turned to these, I would point out some figured specimens which appear worthy of special microscopical examination. The small shells figured by Pusch ('Polen's Palæontolog.,' pl. 5, fig. 14) as the young of *Catillus Brongniarti* have a strong resemblance to *Estheria*, and are the more worthy of examination as they are said to come from the clay-beds above the Jurassic limestone. Figs. 11 and 12 of pl. 37 of Reuss's 'Kreideform. Böhm.' are not so promising; they may really belong to *Inoceramus Crispii* and *I. planus*, to which they are referred. Some of the fossils figured in pl. 17 of Lynch's 'Report on the Geology of the Dead Sea' might possibly be worth re-examination; also the Australian fossil figured in 'Annals Nat. Hist.' vol. xx. pl. 13, fig. 3. The *Posidonomya Wengensis*, Wissman, and *Avicula globulus*, Wissm. 'Münster's Beiträge,' iv. p. 23, pl. 16, figs. 12 and 13, from the St. Cassian beds of the Tyrol, should certainly be looked at by a carcinologist. *Cardinia nana*, de Koninck, 'Anim. foss. Terr. Carb. Belg.' p. 71, pl. 1, fig. 6, is another little shell to be examined. In the 'Geognostische Skizze der Umgegend von Ilmenau am Thüringen-Walde' (Zeitschr. deutsch. geol. Gesell. xii. 1860), Herr Karl von Fritsch remarks (p. 144), "Near Goldlauter, not far from Ilmenau, some beds are nearly full of *C. nana*. These flattened shells remind one of the Triassic *Posidonomya minuta*, Bronn. Perhaps it is the same shell as von Gutbier mentions in his 'Versteinerung. des Rothliegendes in Sachsen,' p. 7."

The long-continued existence of the genus *Estheria*, from a very early period (Devonian) to the present, is a fact of considerable importance to the biologist; the wide geographical range of some of the species (as at present determined), recent and extinct, is also of interest to the naturalist; and in the distribution of the fossil *Estheriæ* amongst the freshwater and estuarine passage-beds of the great successive formations, the geologist will find a fruitful field of research; for, at least, these little fossils will prove to be useful indicators of even transient changes of fresh and salt-water conditions, either in shallow water on coasts, or in inland lakes, where evaporation and the influx of river-water, each varying in amount periodically, may have produced freshwater, brackish, and saline deposits alternately.

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* Prof. M'Coy has already intimated that some so-called fossil shells may be Entomostraca; ('Synopsis of Carboniferous Fossils of Ireland,' 1842, p. 164.)

XXV.—NOTE ON THE FERTILITY, INTER SE, OF HYBRIDS OF DIFFERENT SPECIES OF THE GENUS GALLUS. By S. J. A. Salter.

DURING the last two years some interesting experiments have been conducted at the Gardens of the Zoological Society, under my observation, in reference to hybrids of different species of the genus *Gallus;* their production, in the first place, from distinct species, and their subsequent continuance by breeding *inter se.* The results of these experiments have been very different from what I hoped and expected. The object which was in view in conducting them—to produce persistent races of hybrid fowls, was not accomplished; at least the results were so unsatisfactory as to make it obvious that, with all the care which artificial rearing could afford, the few progeny of these hybrids would not maintain a race—there being evidently a physiological veto against their continuance.

Before describing these experiments and detailing results I would premise a few remarks respecting the subjects of them.

I take it for granted, in the first place, that the different *Galli* upon which these observations were made, are distinct and veritable species according to the most orthodox interpretation of that term; secondly, that the domestic fowl is one and only one of those species; prolific of its kind, and from its domestic habits very manageable, and for these reasons best suited as the female parent of the first generation of hybrids. The different species employed in these observations were *Gallus Sonnerattii*, *G. furcatus*, and *G. Bankiva;* assuming that is, that the domestic fowl, in all its varieties, is the latter, an opinion universally received by ornithologists. The domestic form of *Bankiva* employed was the *game* fowl, the nearest approach to the wild parent stock: full-sized game hens were associated with *G. furcatus*, and bantams with *G. Sonnerattii.*

These efforts at breeding hybrid fowls were commenced in 1861. Previous attempts had been made, many years ago, at the Zoological Gardens, and some of the older keepers, though not giving any very accurate or particular accounts of their history, indicate similar general results to those which have been recently obtained.

In the spring of 1861 a healthy cock *Indian* Jungle Fowl *(G. Sonnerattii)* was associated with several bantam hens. A profusion of eggs resulted; these were very prolific, and yielded chickens in nearly as large a proportion as the eggs of an ordinary poultry yard. The chickens produced from these eggs were numerous and healthy. There appeared nothing in this first cross to militate against the idea of its continuance. One point in reference to the plumage of these birds is worthy of note. The hen birds were all exactly alike, and so were the cocks, but neither could be considered to exhibit the mean average plumage of the two parent stocks—the hen birds most closely resembled those of their male parent; the young cocks were most like the males of their female parent. The pullets, indeed, were so closely similar to hens of true *G. Sonnerattii* as to be scarcely distinguishable from them. The cockerels certainly differed from the bantam cocks of their maternal race, but still only slightly in plumage. The voice, however, was very different, the crow being short, harsh, and discordant. All these hybrids were exceedingly wild. These birds were so numerous that many were disposed of, but sufficient were kept to follow out further the question of hybridising and the fertility of the hybrids. So much for the Sonnerat-bankiva hybrids in 1861.

In the spring of the same year the Zoological Society became possessed of a fine hybrid cock, in which the Jungle-fowl element was that of the species *furcatus*. This bird was evidently bred between *G. furcatus* and domestic *Bankiva* of the variety known as the "Duckwing game." *Gallus furcatus* is very seldom met with in zoological collections, and I was anxious if possible to perpetuate this hybrid as nearly as could be managed by continuing him as the progenitor, and gradually bringing the hens, by successive generations, nearer and nearer to the simple and direct cross. For this purpose I associated some game hens with him, so as to obtain, in the first generation, chickens $\frac{1}{4}$ *furcatus* and $\frac{3}{4}$ *Bankiva*, in the next generation a progeny nearer the jungle-fowl, being $\frac{3}{8}$ *furcatus* and $\frac{5}{8}$ *bankiva*, and so on till in effect the disproportion in favour of *bankiva* was bred out or rather reduced to a very small element. This attempt answered fairly in the first season: two small broods were hatched, and the chickens were reared without much difficulty. As the hens roamed at large and made their nests in some secluded spot in a shrubbery, the number of eggs laid, the proportion hatched, and the condition of the unhatched eggs, were not ascertained. The progeny varied much in plumage. The cocks were destroyed, and three of the most evenly-marked hens were retained for association in the next year, with the half-bred cock, their sire.

The proceedings of 1862 in regard to these hybrid *Galli*, though conducted with the greatest care and attention, led to results quite upsetting all hopes that these races could be practically continued; though at the same time they showed that in a few exceptional instances progeny could be obtained by the breeding of these hybrids *inter se.* The experiments, however, disappointing as they were, gave physiological indications of interest and significance.

The birds intended to be bred from were associated in this order:—

I. Pure *G. Sonneratii* cock, with half-bred (Sonnerat-bankiva) hens:

II. Half-bred Sonnerat-Bankiva cock, with similar hens:

III. Half-bred furcatus-Bankiva cock, with hens ¼ furcatus ¾ Bankiva.

In all cases the mating of the birds appeared to be satisfactory, and the cocks performed their marital duties with vigour. An enormous number of eggs were obtained; but few chickens were hatched, and of those a very small proportion survived. Out of some 500 eggs set under hens, only 12 chickens were reared, and of these only three were from hybrids breeding *inter se*, the other nine being the produce of a pure-species cock with hybrid hens.

The nature of these failures was pretty much the same in all three combinations of cocks and hens above indicated, though the proportion differed somewhat. The character of the results may be stated summarily as follows:—The majority of the eggs showed that they had been fertilized. A large minority gave no such indication, being addled. A majority of the fertile eggs underwent partial development, nearly to maturity, and then aborted; or, being mature, the chickens failed to escape from the shell. Of the chickens hatched the very great majority (more than four-fifths) died within the first few days, or few weeks at latest, *without any obvious cause*, apparently from a mere inability to live. Very many of the chickens were deformed: all such died early.

266 eggs were set under hens at the Zoological Gardens: nearly the same number were sent to the country, and there incubated. The results at the Gardens were carefully noted, and were as follows —the numbers I., II., and III. corresponding with the combinations of the birds as before indicated:—

	Eggs set.	Chickens hatched.	Chickens living.	Dead.	Partly developed.	Eggs addled.
I.	228	45	9	36	43	95
II.	20	1	1	0	8	10
III.	18	3	2	1	5	7

From the eggs sent to the country not one chicken was reared. In other respects the results were much the same as those at the Gardens. I only received numerical records of three settings, which consisted of all three kinds of eggs mixed promiscuously in about equal proportions. The following was the result:—

Eggs set.	Chickens hatched.	Chickens living.	Dead.	Partly developed.	Eggs addled
39	4	0	4	25	10

I may mention that of the four chickens hatched one was furcatus-Bankiva, three were Sonnerat-Bankiva.

The one striking point of these experiments (which, I believe, has never been noticed before) is that a large proportion of these eggs from hybrid birds, breeding *inter se*, have failed to produce young, not from absolute sterility, but from sterility in degree—from an amount of vitalization insufficient to carry out the whole result of reproduction; or, where the young individual has been completed, leaving it with vital resistance too feeble to maintain life and cope with common and customary external influences.

These phenomena have a singular parallel in the circumstances attending parthenogenesis, when it occurs exceptionally in certain Articulata that do not normally reproduce their kind in this manner. In a note published by Mr. Lubbock, in the 7th number of the Natural History Review, p. 345, an epitome is given of some researches conducted by M. Jourdan respecting non-sexual generation in the Silk-worm moth; and it appears that, though some few of the unimpregnated eggs from this insect produced young larvæ, many others underwent the early stages of embryonic development and then stopped. And further, Mr. Lubbock informs me that in some other cases where virgin-reproduction is exceptional, the young thus produced are stated to have perished without obvious cause. Whether any of these young are, under these circumstances, deformed, is a point upon which, I believe, there is no evidence. It seems clear, however, that both in the hybrid-breeding of birds and in exceptional parthenogenesis there is the same kind of defect; that the sterility is not absolute but in degree; and that the stimulus, whatever it may be, which starts the embryonic changes is feeble and imperfect rather than wholly wanting.

XXVI.—On the Brain of the Siamang. (*Hylobates syndactylus*, Raffles.) By William Henry Flower, Conservator of the Museum of the Royal College of Surgeons.

It has been observed by Professor Huxley that, "if the *Primates* " were arranged according to the development of their posterior " cerebral lobes, we should have some such descending series as " the following:—*Chrysothrix*, *Cebus*, *Troglodytes*, Man, ... " *Mycetes*—a series which sufficiently illustrates the classificatory " value of these structures."* The extended observations which have been recently made on the subject have afforded a more complete elucidation of this remark. The various genera hitherto examined may, I think, be placed approximatively in the following order:—an order, it will be observed, as different as possible from one expressing their general zoological affinities. Those marked with an asterisk belong to the New World group. **Chrysothrix*, **Hapale*, **Nyctipithecus*, *Cynocephalus*, **Ateles*, **Cebus*, *Cercopithecus*, *Macacus*, Man (average), *Troglodytes*, *Pithecus*, *Semnopithecus*, **Pithecia*, **Mycetes*. The extreme amount of backward projection of the cerebrum in the Saimiri (*Chrysothrix*) was first pointed out by M. Isidore Geoffroy St. Hilaire,† the opposite condition and the obliquity of the tentorial plane in the Howling Monkey (*Mycetes seniculus*) was shown from a section of a skull in the Museum of the Royal College of Surgeons, by Mr. Huxley in the paper referred to above.

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* On the Brain of *Ateles paniscus*. Proc. Zool. Soc. June 11th, 1861.

I have now to add another term to the series, displacing the American *Mycetes* from the pre-eminence it has enjoyed for nearly two years, as the least occipitally developed of monkeys, and superseding it by one, which we should scarcely have expected to find in such a position, viz. the Siamang (*Hylobates syndactylus—Siamanga syndactyla*, Gray), the most highly organised of the Gibbons, a group ranking after the Gorilla, Chimpanzee, and the Orang, as the most anthropomorphous of apes.

Our knowledge of the cerebral anatomy of the Gibbons is chiefly derived from the figures of the upper and under surface of the brain of *H. syndactylus* given by Sandifort, fairly executed for the time at which they were done, but not sufficiently exact for the requisitions of the present condition of science, and the figures of the cerebrum of *H. leuciscus*, by Gratiolet, in which the cerebellum is not represented. It is due to this eminent anatomist to state that, when speaking of the general form of the brain, he observes that, in comparing the adult Gibbon's brain with that of the Entellus monkey, a relative predominance of the frontal lobe is seen in the former, and of the occipital lobe in the latter; and that, as we descend through the macaques to the lowest baboons, the last named lobe gradually increases in development, although we are not led to conclude, from his description, that there is anything very remarkable in the smallness of the occipital lobe in the Gibbon, as compared with the other anthropoid apes.‡

Among a series of casts of the interior of skulls of various Mammals which have been lately made in the Museum of the Royal College of Surgeons,§ is one of an adult or rather aged specimen of the Siamang (*H. syndactylus*), which presents so many peculiarities of form, that a brief description of it may not be unacceptable as a contribution to our knowledge of the cerebral anatomy of the Primates. As the cast taken from the interior of the skull may be presumed to represent in all its proportions the brain which filled that cavity, I shall in future speak of it as such, and when reference is made to the brain of allied forms, casts of the interior of the skulls of adult male specimens are intended, unless otherwise specified.

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† Archives du Muséum, 1844, and the Zoologie du Voyage de la Vénus.

‡ Mémoire sur les Plis Cérébraux de l'Homme et des Primates. Paris, 1844.

§ These casts are made as follows:—The skull being vertically bisected (unless the calvarium has been removed for the purpose of taking out the brain, when no other incision is necessary) the small foramina and fissures are stopped with clay, the two halves fastened together, and the brain cavity filled through the foramen magnum with a composition of glue and treacle, liquid when warm, but, when cold, forming a firm material taking a beautiful impression of the surface with which

The most obvious characteristics of the general form of this brain (see Fig. 1) are its breadth and great depression. It even exceeds in flatness that of some of the lower apes, and presents a marked contrast to the globular brain of its ally, the Orang. The length of the cerebrum is 3 inches, its greatest breadth 2·5 inches, its height 1·9 inches. Its outline, when seen from above, presents a five-sided figure, with the angles rounded off; truncated behind, with lateral boundaries nearly parallel for more than half their length, and afterwards rapidly converging to the anterior pointed apex. This extremity is prolonged downwards and forwards, and ends in the well developed olfactory bulbs, which project slightly beyond the cerebrum, occupying the cavity of which the floor is formed by the wide cribriform plates of the ethmoid bone, and which has not that extremely contracted aperture seen in the *Cynocephali* and other lower apes. In the depressed and pointed form of the frontal lobes, and the position of the olfactory bulbs, the Siamang departs widely from the more anthropomorphous apes, in all of which the cerebral hemispheres are so developed in the frontal region as to cover the olfactories. But, on comparing this brain with that of a Macaque or Baboon, the under surfaces of the anterior lobes appear less excavated, and consequently contain a larger amount of cerebral substance. The temporal lobes are well prolonged downwards, flattened on their external surface, and when seen from below appear narrow, and standing wide apart from each other.

But the most striking peculiarity of the brain is the backward projection of the cerebellum beyond the level of the cerebral hemispheres, a circumstance, as far as I am aware, unknown in any other ape, either of the Old or New World. On looking from above, both the posterior surface of the vermis, and the rounded edges of the la-

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it is in contact, so plastic that it may be pulled out, without injury, from any underhanging depressions in the skull cavity, and yet so elastic that it will immediately regain its exact form. From this a mould is made in plaster in as many pieces as may be necessary, according to the complexity of the form of the object, and out of this mould any number of casts are taken in the usual manner. These casts give a perfect and most convenient working model of the general form of the brain, which, owing to the peculiar softness of the cerebral tissues, can rarely be preserved in the actual specimen. Their utility has especially been insisted on by Gratiolet.

teral lobes stand out in an unmistakeable manner, the latter to the extent of nearly 2-10ths of an inch. In the cast, the impression of the cavities, in which the lateral sinuses are lodged, give an apparent increase to this projection, but this is readily distinguished from that of the lobes themselves. The median portion or vermis is lodged in a slight vallecula as in the human cerebellum, and although not quite extending to the level of the lateral lobes, is more prominent than in the higher anthropoid apes.

This peculiarity of the Siamang's brain is due to two causes—firstly, the large development of the cerebellum; secondly, and I shall afterwards show, mainly, to the actual shortness of the posterior or occipital lobe of the cerebrum.

It is difficult to find a method of easy application for estimating the proportionate size of the cerebellum to the cerebrum, but I think that the relative breadth of the two portions of the encephalon (which may be ascertained from the skulls alone) affords a measure, approximatively, at least, accurate. The following table, embracing examples of the principal genera of the Old World apes, drawn up upon this plan, shows that, as we descend from the anthropoid forms, the proportionate size of the cerebellum decreases:—

	Greatest Breadth of Cerebrum.	Greatest Breadth of Cerebellum.	Proportion of Breadth.
	Inches.	Inches.	
Troglodytes gorilla . . .	3·75	3·4	100 to 91
T. niger	3·65	3·25	100 to 89
Pithecus satyrus	3·75	3·3	100 to 88
Hylobates syndactylus . .	2·5	2·2	100 to 88
Semnopithecus entellus . .	2·6	1·9	100 to 73
Cynocephalus porcarius . .	2·9	2·0	100 to 69
Cercopithecus delelandii .	2·2	1·45	100 to 66
Macacus rhesus	2·1	1·3	100 to 62

It will be seen by this, that the Siamang is grouped with the three large anthropoid apes, which have all very well developed cerebella, but it does not exceed any of them in this respect.

On examining and measuring a large series of skulls and brains of various apes, it appears to me that the diminution in the size of the cerebellum affects its length far less than its breadth, and is chiefly evident at the antero-lateral portions of each hemisphere. So that the horizontal angle formed by the superior margin of the petrous bone (which marks the antero-lateral attachment of the tentorium, and consequently the margin of the cerebellum) with the median line of the skull, affords a fair index of the proportionate development of the cerebellum. In the Chimpanzee this angle is 55°, in the Siamang the same, in the Entellus monkey 50°, in the Chacma baboon 43°. Diminution of the cerebellum in this region would have no influence upon its backward prominence as related to that of the cerebral lobes, so I conclude that the size of the cerebellum, although it may have some effect, is not largely concerned in the varying extent to which it is covered in the posterior direction by the cerebrum, in the different forms of Primates.

A comparison of the cast, Fig. 1., with that of the brain of either a higher or lower form of ape, will show that the second proposition is well founded. In the brain of most Primates, the line bounding inferiorly the temporal and occipital lobes, commencing at the apex of the former, passes backwards, ascends rapidly, then sweeps backwards again, making a wide curve with the concavity downwards, before terminating at the hinder end of the occipital lobe. In the Siamang this line (marking the tentorial plane) is almost straight, rising at an angle of 40° to the long axis of the brain, and cutting off, as it were, abruptly, that portion of the hemisphere so extensively developed in the *Cynocephali* and *Chrysothrix* (Figs. 2 and 3). And it will be seen by referring to the figures, that it is not alone to the obliquity of the inferior surface that the smallness of the occipital lobe is due; there is also a marked falling away of the upper contour of the brain in the occipital region.

Not being able to deduce anything further from the cast as to the relative proportions of the several parts of the Siamang's brain, and having no actual specimen available for examination, I have had recourse to the recent brain of a young Gibbon of a different species, dissected last summer (and which is now under the care of my friend Dr. Rolleston, in the Museum of the University of Oxford), for some further illustrative facts. This brain has a more globular, and less depressed form than that of the Siamang; this may be partly due to younger age, and partly to specific difference. The cerebellum is very large, and barely covered by the cerebral lobes. The convolutions present the same general characters as those described in the brain of *H. leuciscus* by Gratiolet, but I am able to add that on the inner face of the hemisphere (not figured or described by Gratiolet) it exhibits the anthropic character of an internal perpendicular fissure joining the calcarine, observed also in some *Semnopitheci*, but not in any lower form of Old World apes. The convolutions and sulci of the external surface exhibit a similar high grade of development, as shown by, 1. Their multiplicity, taking into account the small size of the brain. 2. Their want of bilateral symmetry. 3. The superficial position of the superior annectent gyrus, which completely intercepts the external perpendicular fissure on the right side, and partially on the left. The limit between the parietal and occipital lobes is indicated by this fissure, and its backward position shows the reduction of the size of the last.

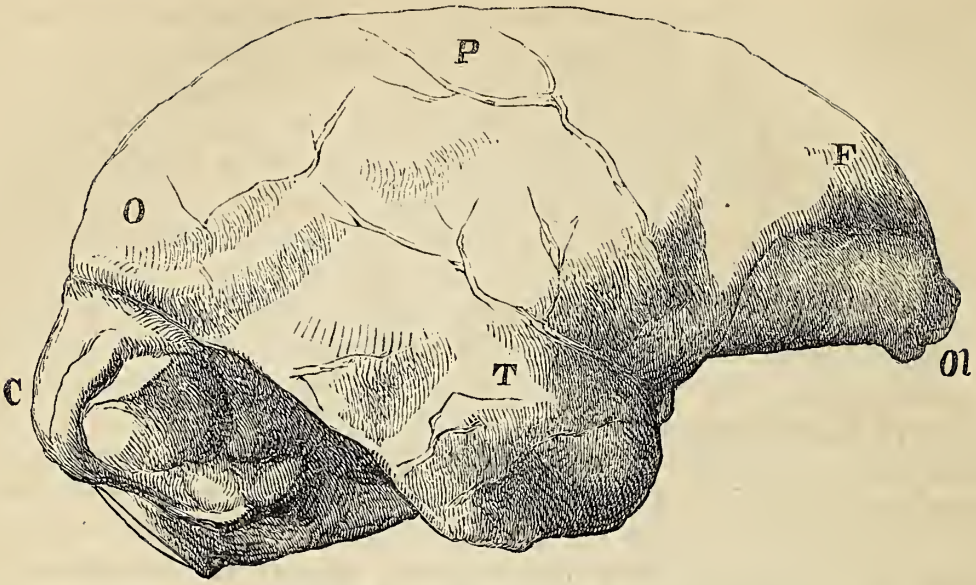

FIG. 1. Cast of the interior of the skull of the Siamang (*Hylobates syndactylus*), adult male.

F. Frontal lobe of cerebrum.
P. Parietal lobe.
T. Temporal lobe.
O. Occipital lobe.
Ol. Olfactory lobe.
C. Cerebellum.

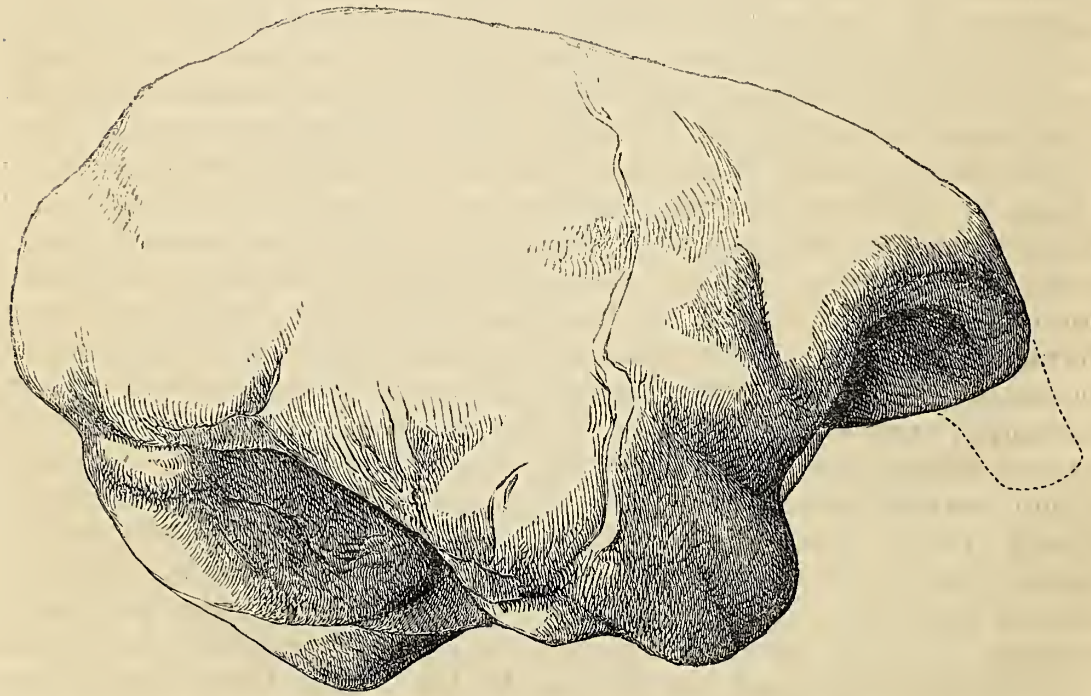

FIG. 2. Cast of the interior of the skull of the Chacma Baboon (*Cynocephalus porcarius*), adult male. The dotted line indicates the outline of the cavity which lodges the olfactory lobes.

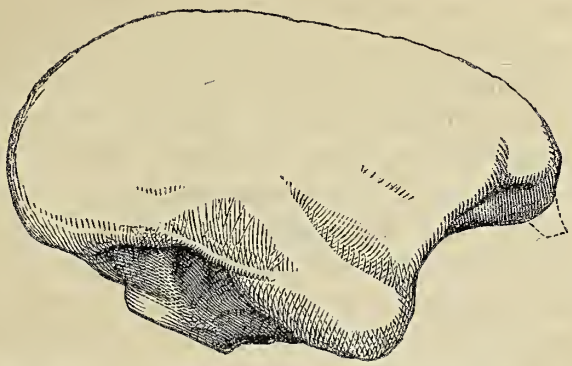

FIG. 3. Cast of the interior of the skull of the Saimiri or Squirrel Monkey (*Chrysothrix sciureus*), adult.

The figures are all from specimens in the Museum of the Royal College of Surgeons, and are of the natural size.

In order to practise the mode of estimating the length of the posterior as compared with the antero-median portions of the cerebrum, which I have described elsewhere,* a horizontal section was made through the right hemisphere, when it was ascertained that the portion anterior to the convex posterior border of the hippocampus major, including the corpus striatum and optic thalamus, measured 1·7 in., while the portion behind this point, including the posterior cornu and hippocampus minor, was but ·7 in.; the proportion being as 100 to 41. On comparing this figure with those in the table given in the appendix to the paper just referred to, it will be seen that it is inferior to that of any true ape yet measured; the figures in other genera ranging from 47 (*Semnopithecus*), to 62 (*Hapale*), the proportion in the Human brain averaging about 53. I have no doubt, from the external form of the lobe, that in the Siamang it would be even less than in the Gibbon.

The above mentioned external characters are all corroborated in a brain of *Hylobates lar*, in the Museum of the Royal College of Surgeons, and an inspection of the skulls of several members of the genus points to the same conclusion, namely, that a very great reduction of the occipital lobe of the cerebrum is one of the most marked characters of the brain of *Hylobates*, although it is not in any other species at present examined carried to so great an extent as in the Siamang. As the Gibbons take rank, by virtue of all their structural affinities, among the higher members of the order to which they belong, we see in this fact a conclusive illustration of Gratiolet's remark, to the effect that the large development of a particular character which distinguishes an elevated group, cannot always be selected as a sign of elevation among the individual members of the group.†

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* "On the posterior lobe of the Cerebrum of the Quadrumana."—Phil. Trans. 1862.

† The genus *Colobus* is not referred to anywhere above, as the brain is at present unknown, but I should infer, from the form of the skull of *C. vellerosus*, that it is closely allied to *Semnopithecus*, though in the shortness of the posterior lobes approaching even nearer to *Hylobates.*

A comparison of the casts (Figs. 1 and 2), and of the numbers given above as indicating the relative breadth of the cerebellum to the cerebrum, will probably strike the physiologist at first sight, as affording some corroboration of the usually received theory of the function of the cerebellum, viz. "that of regulating and combining muscular movements." The Gibbons, as is well known, are the most agile of the apes; the accounts we have received from good observers of the graceful ease and precision with which they take great leaps from bough to bough, sometimes catching with their hands such objects as a flying bird as they pass, are truly surprising; while, on the other hand, the heavy-bodied baboons generally confine their locomotive powers to walking upon the ground, or climbing among rocks.

But physiological conclusions of any value, especially upon the most obscure and difficult of subjects—the functions of the different portions of the nervous centres, must be based upon much wider, as well as more rigidly exact observations. After comparing, as far as I have hitherto had an opportunity of doing, the relative size of the cerebellum with the motor powers of the various forms of quadrumana, the conclusions arrived at are only negative. The active Gibbons have large cerebella, but the organ is equally well developed in the other anthropoid apes. The slower Baboons have a small cerebellum, but so also have the vivacious Cercopitheci and Macaques, zoologically allied to them. An individual of the species whose cerebellum is perhaps the most reduced of all, the Squirrel Monkey (*Chrysothrix sciureus*), (Fig. 3) now living in the Gardens of the Zoological Society, is, the keeper informs me, a lively little animal, capable of taking considerable leaps with great precision, and Humboldt's testimony of its habits in its native state is to the same effect,* while the inert lemur-like Douroucouli (*Nyctipithecus*) has its cerebellum tolerably well developed. In the greater number of the inferior Vertebrata, possessing more or less activity and power of combining and regulating their movements in running, leaping, flying or swimming, that portion of the cerebellum, the great development of which is characteristic of Man and the higher Quadrumana, viz. the body of the lateral lobes, is in a rudimentary condition, or entirely absent. When we consider the complex structure of this organ, and the extremely varying condition of its several component parts in the Mammalia alone, it is evident that it cannot be regarded as a whole in respect to its function, and further difficulties will remain behind, until physiologists have determined what kind of muscular actions in the living animal (whether, as Dr. Rolleston suggests,† the power of maintaining the erect position, exhibited in the slow moving Bears, or, as others suppose, the rapid combination of motor energy, manifested in the Tiger's unerring spring, or the Monkey's airy gambols) are to be regarded as the external indications of the power either of " co-ordination of movements," or of the appreciation of "muscular sensibility indispensably necessary for the performance of complicated muscular efforts."

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* "Ses mouvements sont pleins de grâces. On le trouve occupé sans cesse à jouer, à sauter et à prendre des insectes."—Cours d'histoire naturelle des Mammiféres, par Geoff. St. Hilaire, 1829, 10c Leçon, p. 15.

† Med. Times and Gazette, 1859, Vol. XL. p. 77; and 1860, Vol. I. p. 161.

XXVII.—On the Anatomy of the Olfactory Lobes in certain of the Mammalia. By James Rorie, M.D. Dundee.

To the Anatomist and Physiologist, the Olfactory Lobes present an interest greater than any other individual portion of the nervous system, the spinal cord perhaps alone excepted. From their comparatively isolated condition in many Mammalia, the examination is easily conducted, and in consequence of their immediate relation with an organ of special sense on the one hand, and with the brain proper on the other, a correct knowledge of their anatomical details may be considered as affording, in a great measure, a key to the complex arrangement of nerve fibres which constitute the greater portion of the encephalon, and which has as yet almost completely baffled enquiry.

The most recent information on the anatomy of the olfactory lobes, so far as I am aware, is that afforded by the researches of Ph. Owsjannikow.* The results at which he has arrived, and which may be regarded as representing the present state of our knowledge on the subject, may be summed up as follows:—

1. That in each olfactory lobe a cavity exists, lined by cylindrical epithelium.
2. That the grey matter of these organs is composed of multipolar nerve-cells, from which nerve-fibres pass, some to be distributed on the mucous membrane of the nasal cavities, and others inwards towards the brain proper, terminating in the nerve-cells in the grey matter of the cerebrum.
3. That no commissural fibres could be detected passing between the two olfactory lobes.

The following details, embracing the results at which I have arrived, may not be altogether devoid of interest, for while, to a certain extent, they confirm Owsjannikow's observations, in other respects they differ from them very essentially. The cavities to which the above distinguished observer refers, I have only found to exist in animals which have not reached maturity. In the young

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* Medico-Chirug. Review, No. 54.

Pig (*Sus scrofa*), for example, they are well marked and easily distinguished; while in the full grown Rat (*Mus decumanus*), I could detect no trace of their existence. I am, therefore, inclined to regard them merely as the result of the development of these organs, and not of any essential physiological import. It is to the anatomy of the commissure of the olfactory lobes, however, that I would chiefly direct attention.

On examining the under surface of the brain of most mammalia, a band of white fibres will be seen running backwards and outwards from each lobe, and becoming lost in the grey substance of the brain. This, usually termed the "root" of the olfactory lobe, is simply the band of communication between the olfactory lobes and the cerebrum proper, and its function is evidently that of conveying the impressions made on the olfactory lobe to the grey matter of the brain.

In the Rat these bands are very distinct, and terminate in the outer anterior portion of the cerebrum. Other fibres in connection with these lobes, however, will readily be found, and as they are most easily demonstrated in the above mentioned mammal, I will first describe them as they exist in that animal. On turning aside the white bands already described, and removing gently the grey matter from the inferior surface of the anterior third of the cerebrum, another series of white bands will be perceived as shown in Fig. 1. In order to obtain a clear view of all their relations, it will be necessary to remove the under surface of the olfactory lobes, and to clear away the greater part of the grey matter from the base of the brain, and to turn aside the optic tracts. The following will now be found to be the relation of the fibres referred to:—From the outer and anterior part of each olfactory lobe will be found a small, well-defined, and round band of fibres passing backwards and inwards and uniting immediately posterior to the fissure between the olfactory lobes; or perhaps it may be more correctly described as a band passing in a semicircular direction, the terminations of which are situated in the outer anterior portion of each olfactory lobe. In the Rat this horseshoe shaped band is about the size of fine sewing thread. It evidently constitutes the true commissure of the olfactory lobes. In favourable dissections a few fibres may be seen passing directly outwards from the convexity of the arch and terminating in that part of the cerebrum in which we find the superficial band of fibres connecting the olfactory lobes with the cerebrum to have their termination.

From the inner and anterior portion of each olfactory lobe, a band of fibres arises and passes backwards through the structures at the base of the brain, the two bands slightly diverging from each other in their course. By a careful dissection these bands may be traced till they are lost in the anterior columns of the spinal cord. In the Pig the fibres above described present nearly the same relations as in the Rat, the only differences I could detect being the following:—1st. I could find no fibres passing outwards from the convexity of the olfactory commissure. 2nd. The bands of fibres passing between the olfactory lobes and the spinal cord arose from the outer anterior part of lobe, instead of from the inner as in the Rat, and became lost in the crura cerebri. 3rd. The olfactory commissure terminated in the inner anterior part of the lobes, the outer anterior part being occupied by the long bands just described.

I may here add that an olfactory commissure is not confined to the mammalia. It undoubtedly exists in some fishes. At least I have found it well marked in the Mackerel (*Scomber Scomber*), and occupying a position similar to that already described (Fig. 2). As to the functions which these fibres may be considered to perform, we have already stated that the superficial fibres of communication between the olfactory lobes and the cerebrum may be regarded as conveying to the brain proper the impressions made on the olfactory lobes. The commissural fibres, no doubt, have the same function here as elsewhere, and serve to co-ordinate such impressions.

The functions of the other fibres, however, are not so easily explained. Those arising from the convexity of the commissure may, I think, be regarded as fibres passing from each olfactory lobe respectively to the opposite side of the cerebrum, thus crossing each other in their course. Constituting as they do only about one-fifth of the whole fibres of the commissure, and existing, so far as I could ascertain, in only one of the species examined, their function may be merely of a secondary nature, that of assisting in the co-ordinating action of the commissure. With regard to the fibres passing from the olfactory lobes towards the spinal cord, two views may be entertained; either that they terminate in the spinal centres of locomotion or of respiration. In either case they would appear to constitute a reflex apparatus, whereby locomotion or respiration might be excited independently of cerebral action, an arrangement which must be regarded as highly necessary, when we take into consideration the habits of these animals.

DESCRIPTION OF FIGURES.

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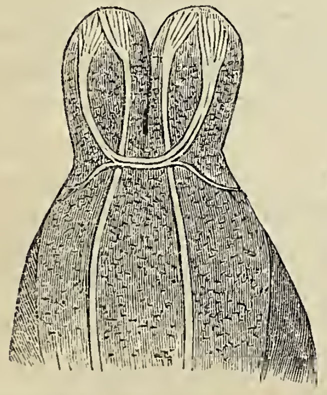

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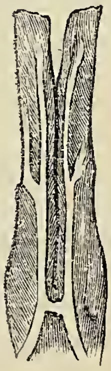

Fig. 1.—Section showing the arrangement of the deep bundles of nerve fibres in the olfactory lobes of the common Rat (*Mus decumanus.*)

Fig. 2.—Section showing the olfactory commissure in the lobes of the Mackerel (*Scomber Scomber*).

XXVIII.—Scotch Kjökkenmöddings.

The Rev. G. Gordon has published a very interesting account of some Kjökkenmöddings on the Elginshire coast, which appear to agree very closely with those found in Denmark. "By far the most "striking," he says, "if not the most ancient example of the Kjök-"kenmöddings we have in our vicinity, is that one which lies within "a small wood on the old margin of the Loch of Spynie, and on a "sort of promontory formed of those raised shingle beaches, so "well developed in that quarter. This mound, or rather these "two mounds (for there is an intervening portion of the "ground that has no shells), must have been of considerable "extent. A rough measurement gives eighty by thirty yards "for the larger, and twenty-six by thirty for the smaller por-"tion. The most abundant shell is the periwinkle. . . . . Next in "order as to frequency, is the oyster . . . . which . . . . as well as "those who had it as a large item in their bill of fare, has passed "away from our coasts. Save in some of the nooks of our Firth, as "at Cromarty, Altirlie, and Avoch, we know not where a small dish "of them could be procured. . . . . As third in order, in this mound, "is the mussel, and then the cockle. Each of these species, how-"ever, bears but a small proportion to either of the former two."

Mr. Gordon informs us, by letter, that similar refuse-heaps are being found all around the shores of the Moray Firth; but it appears that the farmers are gradually carting them away, to serve as manure or topdressings. It is, therefore, much to be hoped that the Scotch antiquaries will lose no time in examining those that still remain.

J. L.

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(*a*) *Crustacea.*

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THE

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Reviews.

XXVIII.—INTRODUCTION TO THE STUDY OF THE FORAMINIFERA. By William B. Carpenter, M.D., F.R.S., etc. Assisted by William K. Parker, Esq., and T. Rupert Jones, Esq., F.G.S. London: published for the Ray Society by Robert Hardwicke. 1862.

THE MICROSCOPE AND ITS REVELATIONS. By William B. Carpenter, M.D., F.R.S., etc. Third Edition. London: John Churchill. 1826.

THE last publication of works on the part of the Ray Society was one, we have reason to understand, which gave considerable satisfaction to the subscribers generally, and which we ourselves could not but regard with favour; first, insomuch as two members of our editorial body contributed, each in his own department, towards its successful issue, and, secondly, because the two volumes, which it comprised, differed so widely in subject-matter from one another.

The merits of Prof. Hofmeister's treatise are well known and justly appreciated, and it is not for us to speak of the manner in which it has been translated by Mr. Currey. The members of the Ray Society may congratulate themselves on possessing a work, which has not, in this its new edition, as yet appeared in the original.

Purely English in its origin, though less extensive in its range, treating, as it does, of only a single order of animals, the work of Dr. Carpenter and his Assistants comes more immediately before our notice. And it is perhaps worthy of record that while the soft parts of the Foraminifera have been best studied by continental naturalists, particularly Dujardin and Schultze, the strangely diversified shells to which these creatures give rise have received their most thorough and complete elucidation at the hands of British investigators.

The present "Introduction" forms a volume in imperial quarto, with more than three hundred pages, twenty-two lithographic plates, and several woodcuts. Why so modest a title has been given to a mass of printed matter so weighty and powerful may seem rather perplexing to the "general reader," who, having gone so far as to peruse the third paragraph of its preface, finds that the work commends itself in some degree to his attention. Let him, however, read farther and his doubts will soon be removed. He will see that zoologists are still ignorant of the entire life-history of any one of these humble organisms, and that little, if anything, is at all known of the occurrence of true sexual reproduction amongst them. He will also learn that the Foraminifera are the lowest forms of animal life; of equal interest, therefore, to the Biologist and more special Zoologist. For (to use Dr. Carpenter's words) their "substance "does not present any such differentiation as is necessary to constitute "what is commonly understood as 'organization,' even of the lowest "degree and simplest kind; so that the Physiologist has here a case "in which those vital operations which he is accustomed to see carried "on by an elaborate apparatus, are performed without any special "instruments whatever,—a little particle of apparently homogenous "jelly changing itself into a greater variety of forms than the fabled "Proteus, laying hold of its food without members, swallowing it "without a mouth, digesting it without a stomach, appropriating "its nutritious material without absorbent vessels or a circulating "system, moving from place to place without muscles, feeling (if it has "any power to do so) without nerves, propagating itself without genital "apparatus, and not only this, but in many instances forming shelly "coverings of a symmetry and complexity not surpassed by those of "any testaceous animals." But the study of these (and other lower) animals, though by no means easy in itself, is relatively far less difficult than that of organisms higher in the scale of being. The contrary is, indeed, often expressed, but a little reflection should suffice to show us its fallacy. This, at least, we can say,—that there are few of Dr. Carpenter's pages which could be considered incomprehensible by any person of good education and intelligence, who, undeterred by a previous want of acquaintance with Zoology, should carefully and patiently endeavour to master their contents. His work, it must be remembered, consists of two successive portions;—the first general, and addressed to all readers; the second more particularly intended for special students of the Foraminifera. The author has himself furnished a well-illustrated resumé of this second section in the tenth chapter of the last edition of his Manual of the Microscope, the title of which we have, therefore, given at the head of the present notice.

The first portion of Dr. Carpenter's monograph, besides a Preface and list of Bibliographical References, includes some sixty-two pages of text, arranged under three chapters. Of these the first presents a historical summary of the progress of our knowledge of the *Foraminifera* from the time of such writers as Plancus to the present day. The second chapter discusses the Rhizopods as a group, dwelling specially on their classification and reproduction. While the third treats "of the *Foraminifera* generally; their chief

“ Types of Structure and Modes of Growth, and the principles to be “ followed in their Classification.”

The general results of the views at which Dr. Carpenter has arrived, touching the mutual relations of the leading types of Foraminifera having not long since been submitted to the attention of our readers, in two articles* which he has himself written for this journal, it becomes necessary that we should, on the present occasion, adopt a somewhat different mode of treatment in reviewing the more extended summary of them brought forward in the preface and first three chapters of the present monograph.

The name Foraminifera, proposed in 1825 by D’Orbigny, is very nearly synonymous in its extent with Reticularia, suggested by Dr. Carpenter as the best appellation of that order of the class Rhizopoda, to which these animals belong. We think, however, that he has wisely, both on its title-page and on most occasions throughout the body of his treatise, seen fit to substitute the older term, since, though not in strictness applicable to certain members of this group, it certainly is true of most of them, and has besides the advantage of having been in constant use for a period of nearly forty years.

Although the great majority of the Foraminifera are shell-bearing organisms, insomuch that the presence of a testaceous envelope is, by most naturalists, invariably associated with their conception of these animals, yet the essential characters of the group as a whole must rather be sought in the minute structure and physiological conditions of the simple tissue, or ‘sarcode,’ constituting the principal bulk of their bodies. This contrasts with the protoplasmic substance of other Rhizopods—

(1.) In exhibiting a feebler degree of histological differentiation; “ for although the external portion is less granular and coloured “ than the internal, and is of somewhat firmer consistence, yet there “ is nothing like a definite distinction between ectosarc and endosarc, “ so that the departure from the original homogeneity of the sarcode “ is here reduced to its minimum. This low grade of differentiation “ is marked also by the absence of the ‘nucleus’ and of the ‘contractile vesicle,’ neither of which organs has yet been detected in “ any members of this group.”

(2.) In the greater tendency to blend of its irregular processes, or ‘pseudopodia,’ which “ present no approach to definiteness, either “ in shape, size, or number. Sometimes they appear cylindrical, and “ sometimes form broad, flat bands; whilst they are often drawn into “ threads of such extreme tenuity as to require a high microscopic “ power for their discernment; they coalesce with each other so “ readily and completely, that no part of their substance can be regarded as having more than a viscous consistence; their margins are

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* Natural History Review for *April* and *October*, 1861.

"not defined by continuous lines, but are broken by the granules "irregularly disposed along them, so that they appear as if torn; "and these granules, when the animal is in a state of activity, are in "continual movement, passing along the pseudopodia from one ex-"tremity to the other, or passing across the connecting threads from "one pseudopodium to another, with considerable rapidity."

Quite recently, the distinguished embryologist, Professor Reichert,* has denied the fact that the pseudopodia of the Foraminifera ever coalesce, while the apparent granular movement he regards as the result of a contractile process in a substance not viscid, according to the view of sarcode usually maintained. The pseudopodia are, in his opinion, distinct organs, which, however closely apposed or modified for a time by contraction, return finally to their original form. The essay in which these curious statements (and many others in support of them) are brought forward is in part polemical, directed against the 'sarcode-theory,' from which Professor Reichert anticipates dangerous results, and in part practical, based on actual observations of living Foraminifera near Trieste. As yet it does not appear to have attracted much attention, but will doubtless before long lead to a further discussion of the really interesting questions which it has raised.

In *Lieberkühnia*† the sarcode-body is naked, or nearly so, but in the closely allied *Gromia* it is furnished with an ovoid, membranous 'test,' having a rounded orifice at one extremity. These two forms of Foraminifera correspond, respectively, to the genera *Amœba* and *Arcella*, or *Difflugia*, in the order *Amœbeæ* (*Rhizopoda lobosa*). "Between the test of *Gromia* and that of *Arcella*, indeed, there is "but little difference; but between the animals which form and in-"habit these tests respectively, the difference is as wide as any that "is known to exist in the whole Rhizopod series; and this difference "has been clearly recognized by MM. Claparède and Lachmann."

In *Gromia* the test usually assumes a brownish yellow tint. "With sugar and sulphuric acid it gives a red colour; whilst by "iodine and sulphuric acid it is turned to a blackish hue with a tinge "of violet." Though soft, "it resists the action of boiling solutions "of the caustic alkalies, and that of the concentrated mineral acids, "even sulphuric." Thus it has been found to differ from cellulose, "and it would seem to have some relation to *chitine* and the sub-"stance of the *horny* tissues." For most of this knowledge we are indebted to the researches of Schultze. The same discoverer has also brought to light an apparently allied genus *Lagynis*, which Dr. Carpenter refers doubtfully to the Foraminifera, thinking its nearer affinities may rather be with *Actinophrys*, an opinion held also, it would appear, by Dr. Wallich.‡

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* Ueber die Bewegungserscheinungen an den Scheinfüssen der Polythalamien, insbesondere über die sogenannte Körnchenbewegung und über das angebliche Zusammenfliessen der Scheinfüsse. Monatsb. Akad. Berlin, Juni, 1862.

† See Natural History Review, 1861, p. 460.

‡ A. N. H. June, 1863, p. 439. His classification of the Rhizopods differs from

Excepting a few arenaceous forms, to which we shall presently refer, the shell is of all other *Foraminifera* calcareous, and, as Professor Williamson has shown, presents two well-marked modifications of *texture*, the 'porcellanous,' and the 'vitreous.'

Among the *porcellanous* forms no minute structure whatever has been observed, either in the substance of the shell itself, or of such projections as may arise to diversify its surface. The shell is opaque-white when seen by reflected light. "When this natural or artificial laminæ of it, however, are viewed with transmitted light, the " opacity gives place to a rich brown or amber colour, which seems " to be imparted by the animal matter that is united with the calcifying deposit, the colour of the sarcode body being usually the " same as that of the shell. In a few instances both the shell and " animal body have a rich crimson hue." Decalcification by dilute acids leaves behind a thin fibre of gelatinous matter, "very distinct " in its aspect from the sarcode-body which the shell included."

"In the shells of the *vitreous* or hyaline type, on the other hand, " the proper shell-substance has an almost glassy transparency; which " is shown by it alike in the thin natural laminæ of young specimens and in artificially-prepared sections of such as are thicker " and older. It is usually colourless, even when (as is often the case " with *Rotaliæ*) the substance of the animal is deeply coloured. In " certain aberrant forms of the Rotaline type, however, we shall see " that the shell is commonly, like the animal body, of a rich crimson " hue. But notwithstanding the transparence of their substance, " these shells derive an adventitious opacity from being channelled " out more or less minutely by tubular perforations, which, when " occupied either by air or by any substance having a refractive " power different from that of the surrounding shell, interfere with " its power of transmitting light, and cause it to reflect a large part " of that which falls upon it. Their effect varies, however, according " to their degree of minuteness and the closeness of their arrangement." In *Rotalia* the average diameter of these perforations is about 1-3000th, in *Globigerina* it varies from 1-10,000th to 1-5000th

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that of Dr. Carpenter in the view which he takes of the nearer affinities both of the *Actinophryds* and *Polycystina.* The former he associates in one order (PROTEINA) with the *Lagynidæ* and *Amœbina;* the latter in a second (HERPNEMATA) with the *Gromida* and *Foraminifera.* The remaining Radiolarian Rhizopods, along with " certain allied but heretofore imperfectly understood pelagic genera," are placed in a third order (PROTODERMATA). Dr. Wallich's arrangement may very briefly be expressed as follows :—

Nucleus distinct.	1. *Proteina.*	A contractile vesicle.
	2. *Protodermata.*	No contractile vesicle.
Nuclear granules diffused.	3. *Herpnemata.*	

Here the Orders follow according to their rank, the highest being first placed. So that, as regards the relative grade of the principal Rhizopod families, the two systems essentially agree.

of an inch. In *Orbulina* two sets of pores appear, the larger, set far apart, some 1-1500th of an inch in diameter, the spaces between these being occupied by perforations which resemble the smaller ones of *Globigerina*. In *Operculina* and its allies all the pores are equally minute and very closely approximated to one another. "It often "happens, however, that certain parts of the shell are left unchan- "neled by these tubuli; and such are at once distinguished, even "under a low magnifying power, by the readiness with which they "allow transmitted light to pass through them, and by the peculiar "vitreous lustre they exhibit when light is made to fall obliquely "upon their surface. In shells formed upon this type we frequently "find that the surface presents either bands or spots which are thus "distinguished; the non-tubular bands usually marking the posi- "tions of the septa, and being sometimes raised into ridges, though "in other instances they are either level or somewhat depressed, "whilst the non-tubular spots may occur on any part of the surface, "and are most commonly raised into tubercles, which sometimes "attain a size and number sufficient to give a very distinctive charac- "ter to the shells that bear them. In shells of this type, however, "which have been long dead and exposed to the action of sea-water, "the vitreous transparence often gives place to a lustrous white "opacity, that is particularly striking in the prominent tubercles; "as is remarkably shown in the tuberculated variety of *Planorbulina* "*vulgaris*. The texture of the shells of this type is much finer than "that of the porcellanous shells; approaching closely to that of the "inferior forms of dentine, or to that of the terminal portion of the "crab's claw." And, among the perforate *Foraminifera* generally the extreme differences of diameter which prevail between the pores are connected with one another by a most perfect series of gradations. Through these pores, whether large or small, the pseudopodia are doubtless protrusible.*

The arenaceous Foraminifera,† though perhaps an intermediate group, come nearer to the perforate than to the non-perforate series. Their shell consists of an aggregation of sandy particles closely compacted together by an exudation from the sarcode body. But in *Valvulina* an envelope of this kind completely invests a primary vitreous layer, in which perforations have been detected.

The shell is either monothalamous or polythalamous. All testaceous Foraminifera are monothalamous at first, but in the great majority the number of chambers increases by a process of continuous budding. There are, however, intermediate forms, in which the shell, though not divided into chambers, has nevertheless the power of indefinite growth. And there are also Polythalamia whose shell-chambers have no internal communication with one another. Such forms, albeit exceptional, are, from a systematic point of view, very significant, and we shall once more have occasion to refer to them.

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* Consult Schultze's figure of a living *Polystomella*.

† See Natural History Review, October, 1861, p. 470.

Among the Monothalamia proper the shell is either spheroidal (*Orbulina*), ovoid (*Ovulites*), or flask-shaped (*Lagena*). In *Squamulina*, a non-perforate form, it has the figure " of an irregular plano-" convex lens, being usually flat, or nearly so, on its attached side " (which accommodates itself to the surface whereon it grows), and " convex on its free side, on some part of which—usually about half " way between the centre and the periphery—is a wide orifice, from " which the pseudopodia issue." In *Lagena* the neck of the flask presents a small circular aperture, which is commonly everted and furnished with radiating notches. The principal orifice of *Orbulina* is scarcely distinguishable from the larger pores. *Ovulites*, on the other hand, has two conspicuous apertures, one at each end of its shell.

The form of the shell among the true Polythalamia is determined, in part, by that of its several segments, chiefly, however, by the mode in which these are added to one another. The segments may, likewise, differ as to size, those first formed being usually the smaller. Three principal directions of growth have been observed: —the *straight*, the *spiral*, and the *cyclical*. Between these, however, intermediate varieties occur, and almost every type exhibits its own minor modifications. Irregular, or 'acervuline'* growths also exist, in which the typical mode of increase, whatever it may be, is marked by the influence of secondary causes. And in such Foraminifera as are attached, the surface on which the shell rests may be brought more or less into play as a modifying agent.

The straight† mode of growth is not a very common one, and is exhibited in perfection only by two generic forms, closely related to *Lagena*. In one of these, *Orthocerina*, no external constrictions are manifest between the successive segments of the shell. In *Nodosarina* such constrictions exist, and the " segments sometimes ex-" hibit a progressive increase, so that the entire shell has somewhat of " a conical form; whilst in other cases each segment has the same " diameter as the preceding, so that the general form of the shell is " cylindrical; and it occasionally happens that the middle segment is " larger than those which precede and follow it, or even that the " primary segment may be the largest, and that the size of the suc-" ceeding segments progressively diminishes. The primordial segment " is often furnished with a more or less prolonged *mucro*." The same form presents itself under some interesting varieties, the two most remarkable of these being the 'frondicularian,'—" of which the " shell is extremely compressed, and of which the segments are so

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* Dr. Carpenter (p. 209) has shown that the *Acervulina* of Schultze, who established for the reception of this genus a special primary group (SOROIDEA), " is nothing else than a *Planorbulina*, which attaches itself to the stem of a Zoophyte or some other small rounded body, and of which the segments, instead of spreading discoidally over an expanded surface, cluster together in a mass, with more or less of regularity of arrangement."

† Or *rectilineal*. The Polythalamia presenting this mode of growth correspond to the group RHABDOIDEA of Schultze.

"prolonged backwards along the two margins that the chambers have "a sagittate form, the aperture being at the point of each,"—and the 'dentaline,' in which the shell is no longer rectilineal, but curved, though connected with the absolutely straight *Nodosarina* by imperceptible gradations. In these and other cases the form of the aperture alters along with that of the shell and, from being circular, becomes oval, crescentic, reniform, or even triangular, while in the so-called *Rimulina* (one of the dentaline modifications of *Nodosarina*) it appears as "an elongated fissure, extending through a large "part of the convex side of the anterior wall of the chamber."

Much more frequent is the *spiral** mode of growth, which is 'nautiloid' (equilateral), when all the whorls lie in the same plane; 'turbinoid' (inequilateral), in a series of planes. As the successive chambers (and whorls) increase or remain nearly equal in size, so does the resulting spiral, whether nautiloid or turbinoid, also vary. Again, its earlier whorls may, to a greater or less extent, be invested by those which succeed, and in the nautiloid forms especially the first-formed whorls are thus often concealed. "Now, the degree of "this investment is determined by the degree in which the successive "segments of the sarcode-body of the animal send out lateral lobes "that extend themselves over the previously formed portion of the "shell; and this is manifested in the shell by the development of "what may be termed the *alar prolongations* of the chambers which "are the portions formed to include those lobes." The nautiloid spiral is well represented by *Polystomella;* the turbinoid, by *Rotalia*, the best type, perhaps, of the entire group of Foraminifera. In *Miliola* we have a curious modification of the nautiloid spire; the shell being elongated in the direction of one of its diameters, the opposite extremities of this indicating the limits of the two chambers, of which each whorl is made up. So, on the other hand, we may regard as modifications of the turbinoid mode of growth such shells as those of *Textularia* and *Bulimina*. In the former, the number of chambers in each plane is so small that the shell appears to consist of a double series of segments, alternating on either side of a straight axis. *Bulimina* (in its more usual form at least) carries the same modification still further, for here the spire becomes uniserial.

The *cyclical* mode of growth is best exhibited by *Orbitolites* and *Cycloclypeus*, and has been made intelligible to all interested in the study of the *Foraminifera* since the appearance of the first series of Dr. Carpenter's 'Researches' on these animals, published in the Philosophical Transactions for 1856. In this Memoir the structure of *Orbitolites* was minutely described, the curious variations to which this type is subject being, likewise, noticed at considerable length. And in the second series of the same essays the more complex organization of the much rarer *Cycloclypeus* was also made clear. In both these discoidal shells the chambers form a succession of concentric zones, each completely surrounding its predecessor, with which it communicates by its series of marginal apertures. The chambers (as often happens in the spiral type) are further divided into secondary 'chamberlets.' But while, in *Orbitolites*, these freely open into one another, this is not the case with *Cycloclypeus*, so that its direction of growth, as Dr. Carpenter observes, "is in reality rather *radial* than cyclical."

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* Or *helical.* HELICOIDEA of Schultze.

Transitional conditions between these three leading modes of growth are readily found. Thus the straight shell of *Nodosaria* is connected with the spiral *Cristellaria* by a number of intermediate forms so gradually increasing in curvature that the entire series has been included in a single comprehensive genus,—*Nodosarina*. So, likewise, in the nautiloid *Peneroplis* we often notice that "the spire "becomes disengaged, and prolongs itself in a straight line, its successive chambers exhibiting little or no increase in size." Between the spiral and cyclical types, on the other hand, the genera *Orbiculina* and *Heterostegina* may be said to inosculate. Both shells commence the multiplication of their chambers after the spiral mode, and "the "earlier convolutions invest those which precede them, whilst the latter "extend themselves peripherally instead of centrally, and the mouth "of the spire or 'apertural plane' widens on each side so as to pass "round (it may be) the whole circumference, and thus to convert the "spiral into the cyclical plan of growth." These two discoidal shells, in spite of their very different aspect, are intimately related to *Alveolina* and *Fusulina*, respectively, in which the axis of the spiral becomes more or less elongated, and the shell, in consequence, assumes a fusiform or ellipsoidal figure.

The spiral plan, on the whole, may certainly be said to predominate. A majority of the Polythalamia exhibit this mode of growth, and this only; and in comparatively few generic forms has it not yet been observed. While both the straight and cyclical types, as we have seen, are often spiral at some period or other of their life. Even *Orbitolites* is liable occasionally to commence its growth after the spiral method.

Orbitolites is further remarkable for its tendency to pass into a complex type which, though connected with the simpler form by unmistakeable gradations (sometimes observable even in different parts of the same specimen) offers, nevertheless, in its extreme condition, a well-marked modification of the polythalamous structure. Here the simple disc is replaced by two 'superficial layers' and an intermediate stratum, and the margin of the much thickened shell is furnished with several series of pores, placed one above the other. The chambers of the superficial layers are oblong, not rounded, as in the simple type, and their mode of communication with one another horizontally is likewise different. Vertically they are brought into connection by columnar sub-segments of sarcode, traversing the principal thickness of the disc.

Both the simple and complex types of *Orbitolites* have obviously some relation, however distant, to *Dactylopora*, which presents us with a mode of growth distinct from any of those noticed above, and whose structure is, in more than one respect, so peculiar as to render it, perhaps, the most sharply definable genus of all the polythalamous *Foraminifera*. The more highly specialised forms of *Dactylopera* have a somewhat cylindrical shell, the interior of which is hollow, while within the substance of its wall are lodged the chambers, converging side by side, so that their apertures are directed rather obliquely towards the axis of the cylinder, and forming a succession of annuli or superimposed storeys. The chambers do not communicate with one another internally, but open, separately, into the cavities of a very curious 'interspace system,' the lateral prolongations of which terminate in two sets of orifices scattered over both surfaces of the shell wall. In the closely allied but less elaborately constructed *Acicularia*, the apertures of the chambers are turned towards the periphery of the shell.

With regard to the acervuline modifications which some *Foraminifera* tend to assume, their very irregularity forbids our making any definite observations respecting them in general. One of the most singular is offered by the imperfectly polythalamous genus *Nubecularia*, chiefly distinguished for its power of employing the surface of attachment which it selects, to form portions of its shell-wall. And in *Polytrema*, which, as Dr. Carpenter shows, is nothing but a modified Rotaline, the shell assumes a zoophytoid aspect; "for although it sometimes spreads itself as a scaly incrustation on "the surfaces of shells, corals, &c., it not unfrequently rises from "those surfaces in an arborescent form; whilst sometimes its stalk, "instead of branching, swells into a globular protuberance." Very interesting acervuline forms are also presented by *Planorbulina* and *Tinoporus*.

The form of the *septal plane* among the *Polythalamia* "is in "direct relation, not merely with the general contour of the shell, "alike in its lateral and in its antero-posterior aspects, but also with "certain of its surface-markings." Thus, in the case of nautiloid shells, the degree to which alar prolongations are developed, and encroach externally upon the walls of the previously formed chambers, modifies the shape of their septal divisions to a corresponding extent. As already stated, in some of the more complex *Foraminifera* we find the chambers sub-divided into chamberlets by secondary septa running at right angles to the primary ones. In those multilocular forms which are placed in one family with *Lagena*, the septa resemble in structure the rest of the shell-wall: in the higher PERFORATA, on the other hand, they are completely differentiated from it, and want its characteristic tubuli. The orifices of the septa vary considerably in size, form, and situation. They may be single, or multiple; entire, or with a divided and branching margin. And in the typical *Nummulinida* the septal aperture becomes "a narrow "fissure that is left between the outer margin of the penultimate "convolution and the inner margin of the septum; and alike in "its form, and in its position with regard to the two lateral sur-"faces of the shell, it is consequently quite symmetrical." In the IMPERFORATA, as might be expected, the septal orifices are comparatively large, and in *Miliola* are reduced to the condition of mere constrictions, furnished with a tongue-like projection, or 'valve,' while in *Nubecularia* and *Vertebralina* they almost wholly disappear. And thus we are led to such pseudo-polythalamous forms as the nautiloid *Cornuspira*, in which the cavity of the shell is quite undivided. In extreme contrast with this low type of structure we may cite the family of *Nummulinida*, among which, with one exception, the septal planes are double, so that each chamber of the shell is furnished with a wall of its own.

This duplication of the septa is accompanied by the presence of another and highly important advance in organization; the development, namely, of an 'intermediate' or 'supplemental skeleton,' for the nutrition of which a peculiar system of 'interseptal canals' is provided. The interior of these canals, as of the interspace-system (their apparent representative) in the non-perforate *Dactylopora*, is quite distinct from though connected with the cavities of the chambers. In the higher members of the Rotaline group a supplemental skeleton also occurs, and in *Calcarina* constitutes the entire substance of the large club-shaped processes with which this curious form is ornamented. In other spiral shells, it "not " only fills up what would otherwise be superficial hollows at the " junctions of the chambers, or (as in *Polystomella*) at the umbilical " depression, but often forms a layer of considerable thickness over " the whole surface, thus separating each whorl from that which en- " closes it." When this deposit is very scantily developed, an interseptal system ceases to be necessary. " The passages which make " up this 'system' are not true *vessels*, but are mere *sinuses*, left in some " cases by the incomplete adhesion of the two contiguous walls which " separate the adjacent chambers, and in other cases apparently " originating in the incomplete calcification of the sarcode which " forms the basis of the solid skeleton; certain portions of that sub- " stance remaining in their original condition so as to maintain a " communication between the contents of the chambers and the parts " of the calcareous skeleton most removed from them, analogous to " that which the Haversian canals afford in the case of laminæ of bone " not in the immediate vicinity of a vascular surface. As, therefore, " the development of the Haversian system is related to the thick- " ness of the bone-substance to be nourished, so does that of the " canal-system in Foraminifera seem to be related to the amount of " consolidating substance which constitutes the supplemental skele- " ton. There is good reason to believe that these canals are occupied " in the living state by prolongations of the sarcode-body, which " pass from the chambers into the portions of the system in nearest " relation to them, and proceed to its peripheral extensions; and " they are largest and most numerous when nutriment has thus to " be conveyed to parts of the supplemental skeleton, which (like the " outgrowths of *Calcarina*) are very far removed from the segments " of the ordinary sarcode-body."

The *surface of* the shell in all Foraminifera is either smooth or diversified by some external sculpture, of those "there are two principal kinds, which are for the most part related to the 'porcellanous' "and the 'hyaline' types of shell-structure respectively." In the porcellanous types the surface-marking is prone to take the form of pits or striæ. "Among the 'hyaline' shells, on the other hand, "variety is given to the surface-marking chiefly by the interposition "of bands or spots of non-tubular substance in the midst of the "tubular; such portions being distinguished by their vitreous lustre "from the general surface, even when they do not project above it. "Most commonly, however, they are raised into ridges or tubercles; "and these are sometimes arranged with great regularity, whilst in "other instances they are extremely variable."

Finally, as to the variations in size which the Foraminifera present, a few words may be said. Among the smallest forms may be mentioned the naked *Lieberkühnia*, the diameter of which is about 1-400th of an inch, and *Squamulina*, whose single-chambered shell is 1-300th of an inch in its greatest length. *Ovulites* "is the largest of "the monothalamous *Foraminifera;* its one segment, which is "usually about the size of a mustard seed, equalling in bulk the "entire polythalamous shells of ordinary *Miliolæ*, *Rotaliæ*, &c." *Pullenia*, a very small polythalamian has a "diameter averaging "1-50th and never exceeding 1-30th of an inch." But on the whole the Polythalamia far exceed the Monothalamia in size. The most notable Foraminifera in this respect are also the most highly organized, and belong to the family of *Nummulinidæ*. The disc of *Cycloclypeus* measures 2¼ inches in diameter, while that of *Nummulites* itself varies from 1-16th of an inch to 4½ inches. Next to *Cyclolypeus* the complex type of *Orbitolites* is the largest of all the recent *Foraminifera*.

The two principal features of Dr. Carpenter's monograph will be found to consist—first, in the lengthened account which it contains of the structure of each particular type belonging to the Foraminifera; and, secondly, in the general classification of these animals, wherein, so to speak, the anatomical facts thus detailed are systematically summed up. It is true that, in his "Researches on the Foraminifera," he had already explained the organization of twelve of the most remarkable types belonging to this Order. Not only, however, are the results of these memoirs now again set forth, subject to such revision as seemed needful, but a large number of generic forms are here described, our previous knowledge of which had hitherto, with few exceptions, been most incomplete and unsatisfactory. Although the author's peculiar method of investigating these types, by the careful comparison of thin sections of their shells made in different directions, had enabled him, in most cases, to arrive at tolerably complete conceptions of their conformation, he has, nevertheless, gladly welcomed the additional light which later opportunities of examining entire casts of the Foraminifera have, so unexpectedly, imparted.

> "An entirely new and most valuable source of information in regard to the organization of the Foraminifera has recently been afforded by the discovery, first announced by Professor Ehrenberg in 1853, that their shells occasionally undergo an infiltration of silicate of iron, that completely fills, not merely their chambers, but their canal system, even to its minutest ramifications; so that if a shell thus infiltrated should itself undergo decomposition, a perfect internal cast remains of the original body of the animal, with its extensions throughout the shell. Of such casts it has been shown by Professor Ehrenberg that the Green Sands which present themselves in the various geological formation, from the Silurian system upwards, are in great part composed; and his discovery has thus a twofold value, as, on the one hand, it places before us far more exact representations of the configuration of the animal body, and of the connections of its different parts, than we could obtain even from living specimens by dissolving away their shells with acid (its several portions being disposed to heap themselves together in a mass when they lose the support of the calcareous skeleton); whilst it also enables us to identify with greater certainty the types of Foraminifera, by which these casts were originally formed, notwithstanding the entire destruction of their shells. It was soon afterwards shown by Professor Bailey (U. S.), that a like process of infiltration is taking place at the present time over certain parts of the ocean bottom, and that beautiful internal casts are obtainable by treating with dilute acid Foraminiferous shells whose cavities have thus filled. By the application of this method to portions of Mr. Juke's Australian dredgings, Messrs. W. K. Parker and T. Rupert Jones have obtained a series of internal casts of most wonderful beauty and completeness, which I have had the advantage of carefully examining; and it is with great satisfaction that I can state that in no instance has this examination afforded me any other result, that of confirming the conclusions to which I had been previously led by the study of the shell."—(p. 10.)

Besides the original observations of Dr. Carpenter himself, which constitute, indeed, the chief portion of its contents, his treatise makes copious reference to the labours of other workers in the same field, especially of Max. Schultze, Williamson, and Carter. While the peculiar nature of the aid rendered by his assistants, Messrs. Jones and Parker, to whose most painstaking inquiries the author has truly awarded the praise so justly their due, adds not a little to its value as a work of reference. Here, again, it is necessary that we should quote Dr. Carpenter's words:—

> "I found, moreover, that notwithstanding the dissimilarity between the lines of inquiry pursued by myself on the one hand, and by my friends, Messrs. Parker and Rupert Jones on the other, they led to conclusions most singularly accordant. My own studies had been restricted to a limited number of types (for the most part collected by Mr. Jukes on the Australian coast, and by Mr Cuming in the Philippine Seas), which included, however, all the most complex and highly developed forms of recent Foraminifera; and I had specially devoted myself to the elucidation of their structure and physiology, and to the careful comparison of their numerous varietal forms. Theirs, on the other hand, had involved the comparison of the zoological characters of vast numbers of representatives of nearly all the generic types of the group, fossil as well as recent, brought together from various parts of the world, from various depths in the ocean, and from various geological formations: but had not been prosecuted with the same minuteness in regard to the details of internal structure or to physiological relations."—Preface, p. v.

> "Not only, moreover, did there prove to be this complete harmony in our general results, but there was also a singular unity in the aggregate of the work we had respectively accomplished, each portion being, so to speak, the complement of the

other; so that, on comparing notes, we found that we had between us pretty thoroughly investigated the entire group. Hence I was led to propose to the Council of the Ray Society an enlargement of my original plan, so as to include the results of my friends' labours, and to render the whole an expression of our joint views. This I did in the expectation that we might associate ourselves together in such a manner that whilst the general plan and a part of the details of its working out would rest with me, a large share in the execution would be taken by my coadjutors. We soon found, however, that it would be more conducive both to unity of design and to completeness of effect for the whole to be wrought out by myself; and it has been by the necessity which thence arose for my personal study of many types with which I was previously but little or not at all acquainted, that the delay in the production of the work has for the most part been occasioned. The materials for this study have been most liberally supplied to me by Messrs. Parker and Rupert Jones; and as to many types which they had previously made the object of special researches (such as the *Milioline*, *Nodosarine*, *Textularine*, and *Rotaline* groups), I have found that I had nothing to do but to accept their well-considered and satisfactory conclusions. In certain other cases, especially in regard to the genus *Dactylopora*, and to that collection of forms which they had described under the generic designation *Orbitolina* (here referred to the genera *Tinoporus* and *Patellina*), my own investigation of the materials which they have placed in my hands has led to results in some respects different from those which they had published; but as they have seen reason to accept my modifications, the accounts of those types here given may be regarded as not less theirs than mine. In regard to the genus *Nummulina*, the most important of all Foraminifera in a geological point of view, we have found ourselves in complete accordance as to the impossibility of drawing definite lines of demarcation between its reputed species; my researches on the varietal forms of the closely related genus *Operculina* having led me to conclusions as to the variability of all the differential characters on which reliance had been placed, precisely corresponding with those at which Messrs. Parker and Rupert Jones had arrived from a careful comparative study of the various forms of *Nummulina* proper. I have endeavoured, as each genus came successively under review, to specify what share in the special investigation of its character is due to my coadjutors, and what has been more particularly my own; where no such intimation is given, we may be regarded as jointly responsible."—Ib. p. vi.

In this manner all the Foraminifera known to these three investigators have been reduced to about fifty-two separate genera, included by Dr. Carpenter under six families and two sub-orders. To the various names of the families and sub-orders given in the accompanying table, we have ventured to append approximate definitions:—

FORAMINIFERA.

Sub-order 1. IMPERFORATA.

Shell varying in texture, furnished with a single or multiple orifice on its apertural plane, but otherwise imperforate. Pseudopodia only protrusible from the anterior region of the body.

Family I. Gromida.—Shell wanting, or replaced by a single-chambered membranous test.

Genus 1. Lieberkühnia.
„ 2. Gromia.
Genus 3. Lagynis.

Family II. Miliolida.—Shell calcareous, porcellanous, imperforate.

Genus 1. Squamulina.
,, 2. Cornuspira.
,, 3. Nubecularia.
,, 4. Vertebralina.
,, 5. Miliola.
Hauerina.
,, 6. Fabularia.
Genus 7. Peneroplis.
,, 8. Orbiculina.
,, 9. Alveolina.
,, 10. Orbitolites.
,, 11. Dactylopora.
,, 12. Acicularia.

Family III. Lituolida.—Shell made up of an aggregation of sandy particles.

Genus 1. Trochammina.
,, 2. Lituola.
Genus 3. Valvulina.

Sub-order 2. PERFORATA.

Shell always calcareous, vitreous, with numerous scattered pores, through which the pseudopodia are protusible.

Family I. Lagenida.—Shell finely tubular, hard, and glossy, frequently overlaid by non-perforate exogenous growths. Chambers more or less flask-shaped, each having a central, circular, often elongate aperture, the margin of which is usually everted or radiate. Septa single, prominent, not differentiated in structure from the rest of the shell-wall. No canal-system or intermediate skeleton.

Genus 1. Lagena.
Entosolenia.
,, 2. Nodosarina.
Nodosaria.
Cristellaria.
Intermediate forms.
Genus 3. Orthocerina.
,, 4. Polymorphina.
,, 5. Uvigerina.

Family II. Globigerinida.—Shell coarsely perforate. Septa single or double, each with a crescentic aperture.

Genus 1. Orbulina.
,, 2. Ovulites.
,, 3. Spirillina.
Sub-family Globigerinæ.
Genus 4. Globigerina.
,, 5. Pullenia.
,, 6. Sphæroidina.
,, 7. Carpenteria.
Sub-family Textularinæ.
Genus 8. Textularia.
,, 9. Chrysadilina.
,, 10. Cuneolina.
Genus 11. Bulimina.
,, 12. Cassidulina.
Sub-family Rotalinæ.
Genus 13. Discorbina.
,, 14. Planorbulina.
,, 15. Pulvinulina.
,, 16. Rotalia.
,, 17. Cymbalopora.
,, 18. Calcarina.
,, 19. Tinoporus.
,, 20. Patellina.
,, 21. Polytrema.

Family III. Nummulinida.—Shell usually symmetrical, dense, finely perforate. Septa completely differentiated and (save in *Amphistegina*) double. Aperture a narrow, continuous, or interrupted cleft. Intermediate skeleton and canal system highly developed.

Genus 1. Amphistegina.
„ 2. Operculina
„ 3. Nummulina.
„ 4. Polystomella.
Nonionina.
Genus 5. Heterostegina
„ 6. Cycloclypeus.
„ 7. Orbitoides.
„ 8. Fusulina.

It will be seen that this classification is distinguished at once by positive and negative characters. First, as to the former, Dr. Carpenter's two primary divisions rest upon an appreciation of almost the only possible difference in ‘plan of structure,’ which in animals so simply organised as the Foraminifera could be expected to occur. This, in its turn, involves a corresponding difference as to the relation subsisting between the soft animal body and the medium wherein it lives. The relation of the shell itself to the sarcode substance, and of its several chambers to one another, among the polythalamous forms, are, by the same comprehensive distinction, also reorganized. The families of the higher sub-order, *Perforata*, are differentiated from one another by minor modifications of those very characters on which the sub-order itself has been established, while in the *Imperforata* the texture of the shell, whether membranous, calcareous, or arenaceous has been taken into account. Many will doubtless regard Dr. Carpenter's genera as too condensed, and find fault with his opinion of the worthlessness of specific distinctions within the Foraminiferous group. Let such persons, however, proceed to study these animals for themselves and, sooner or later, they will not fail to become convinced that "*sharply-defined divisions*—whether between species, genera, families, or orders—*do not exist among Foraminifera.*" Who can absolutely distinguish between *Orbiculina* and *Alveolina*, widely dissimilar as are these genera in their extreme forms from one another? The two great families *Globigerida* and *Nummulinida* have their characters united in such genera as *Amphistegina* and *Rotalia*. Even the sub-orders *Perforata* and *Imperforata* are brought together by *Valvulina*, a genus which may well be considered as occupying an intermediate position "since, although its shell is constantly arenaceous, and is (for the most part) *practically* imperforate, yet it is formed on the basis of a perforated vitreous lamina."

Among the negative characteristics in Dr. Carpenter's arrangement, the small value therein attached to *direction of growth* and *the distinction between monothalamous and polythalamous shells*, should most prominently be mentioned. Let it be remembered that two Foraminifera, having the same direction of growth, and consequently the same extreme form, may differ in almost every other respect. It is by no means rare for shells to change their direction of growth as they become older, and we have already hinted that even different parts of the same specimen may appear to point to two dissimilar modes of increase. Among the higher Foraminifera, the direction of growth varies with some approach to regularity, and, as Dr. Carpenter has shown in the annexed table, affords the means of indicating representative groups within the limits of the Porcellanous and the Vitreous series respectively :—

	Porcellanea.	*Vitrea.*
Simple complanate spiral . .	Peneroplis.	Operculina.
Spiral, with the chambers subdivided into chamberlets . . .	Orbiculina.	Heterostegna.
Cyclical, with annuli subdivided into chamberlets	Orbitolites.	Cycloclypeus.
Spiral, with elongated axis, chambers subdivided into chamberlets .	Alveolina.	Fusulina.

Cornuspira, in like manner, represents the vitreous *Spirillina* and the aranaceous *Trochammina*.

The inadmissibility of the Polythalamia as a separate group, is at once proved by the fact that their sole distinctive feature does not correlate with any other worth insisting on ; for Polythalams differ among themselves, as do Monothalams, in characters of such importance as the perforation and non-perforation of the shell, its texture, and the nature of its perforations, when present. What these differences imply, we have already endeavoured to show. The general analogy of Zoology plainly enough demonstrates, that the power of multiplying by continuous gemmation, however interesting from a physiological point of view, is, in most cases, too variable a character to be of any value to the systematist. With regard to the *Foraminifera* in particular, this question has been set at rest by the discovery of three polythalamous genera,—*Dactylopora, Acicularia,* and *Globigerina,* in which the separate shell-chambers do not communicate with one another internally. In *Carpenteria* all the chambers open into a common vestibule. That the passage from Monothalamia to Polythalamia is, in truth, a gradual one, is further indicated by the existence of what Dr. Carpenter terms *potentially* polythalamous* forms, which, though *actually* monothalamous, have the power of indefinite shell-growth. Thus, in one family, *Miliolida,* the following gradations may be pointed out.

1. True Monothalamia.—*Squamulina.*
2. Monothalamia with indefinite growth.—*Cornuspira.*
3. Monothalamia (?), in which irregular chambers are foreshadowed. —*Nubecularia ; Vertebralina.*
4. Polythalamia, with large chambers, separated only by constrictions. —*Miliola.*
5. Polythalamia with true septa.—*Peneroplis.*
6. Polythalamia with milioline chambers, irregularly sub-divided.—*Fabularia.*
7. Polythalamia with true septa, and chambers subdivided into chamberlets.—*Orbiculina; Alveolina ; Orbitolites.*

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* See Natural History Review, October, 1861, p. 468.

8. Polythalamia, in which the cavities of the chambers do not directly communicate.—*Dactylopora; Acicularia.*

Perhaps the two last mentioned genera should constitute a separate family. But, as Dr. Carpenter hints, it is possible that we may yet discover the extinct forms which intervene between these and other Foraminifera; the existence of *chains of affinities*, binding together the most varied members of this group, having been now established in so many directions.

Thus, from the systems of D'Orbigny, Schultze, and even of Lachmann and Claparède, the above classification differs in some very important features. On the other hand, in its most striking positive characteristics, it accords with the lately-published arrangement of Professor Reuss,* whose views as to the affinities of the Foraminifera would seem, for the most part, to have been the result of quite independent research. The following are the families admitted by Professor Reuss. For the sake of brevity we have not given the names of his sub-families and genera:

A. Foraminifera with imperforate shell.†
  A. Shell arenaceous.
    1. *Lituolidea.*
    2. *Uvellidea.*
  B. Shell calcareous, porcellanous, compact.
    1. *Squamulinidea?*
    2. *Miliolidea.*
    3. *Peneroplidea.*
    4. *Orbitulitidea.*

B. With perforate shell.
  A. Shell calcareous, vitreous, finely porous.
    1. *Spirillinidea.*
    2. *Ovulitidea.*
    3. *Rhabdoidea.*
    4. *Cristellaridea.*
    5. *Polymorphinidea.*
    6. *Cryptostegia.*
    7. *Textilaridea.*
    8. *Cassidulinidea.*
  B. Shell calcareous, with multiple pores.
    1. *Rotalidea.*
  C. Shell calcareous, traversed by a ramifying canal-system.
    1. *Polystomellidea.*
    2. *Nummulitidea.*

As to differences of *grade of complexity* among the Foraminifera it may be said that, as a general rule, to which exceptions exist, perforate are higher than imperforate; Polythalamous than Monothalamous forms. Among the *Imperforate* we meet with membranous, calcareous, and arenaceous shells; in the *Perforata*, with calcareous shells only. The *Imperforata* never acquire double septa, and their supplemental skeleton, when present, is different from that of the *Perforata*. Lastly, among the *Imperforata* there is but one example (*Spirillina*) of a Monothalam with indefinite growth, and it is only within this division that the straight mode of growth can be said to attain its full development, while, on the other hand, the cyclical type is better manifested by *Orbitolites* than by *Cycloclypeus*.

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* Nachschrift to his 'Entwurf einer systematischen Zusammenstellung der Foraminiferen.' Wien. Sitz. October, 1861.

† Reuss now places the *Gromidæ* with *Difflugia.*

The *distribution* of the *Foraminifera* may be dismissed in a few words. The *Gromidæ* (which many writers would exclude from this order) are fresh-water as well as marine, but all the Foraminifera proper exclusively inhabit the sea. Though some are litoral, the majority flourish best in deeper waters, and, in this respect, they may fairly be contrasted with the Radiolarian Rhizopods, very many of which assume a pelagic habit. Certain genera, more especially *Globigerina* and its immediate allies, are among the most notable members of the abyssal Fauna, and there is good reason to suppose that these may serve as food for larger animals found with them in the same regions.

Glancing at their geographical distribution we are chiefly struck by two facts, namely—first, the wide range of several genera, as *Miliola*, *Textularia* and *Globigerina*; secondly, the preponderance in tropical seas of the largest and most highly organized Foraminifera, whether belonging to the perforate or imperforate series. Thus, of the latter, *Orbiculina*, *Alveolina* and *Orbitolites*; and of the former, *Calcarina*, *Amphistegina* and *Heterostegina* very imperfectly exhaust the list of genera restricted to the warmer seas of the globe. *Cycloclypeus* has hitherto been met with but in one locality, off the coast of Borneo. Other forms, of which *Polystomella* is a good example, though found in most seas, fail to attain complete development, whether as to size or complication of structure, outside the limits of the tropics. Of the forty-six genera of Foraminifera now living, only twenty-seven occur in the British Fauna. Two, however, of these, *Vertebralina* and *Peneroplis*, would seem to be but casual inhabitants of our seas, having been probably wafted thither by ocean-currents. Dr. Carpenter has given in an Appendix a tabular view of the revised "names assigned by Messrs. Parker and Rupert Jones to the species and varieties described and figured in Professor Williamson's Monograph on the Recent Foraminifera of Great Britain."

The general relations of the Foraminifera to time are briefly summed up in the accompanying table, based chiefly on the data recorded by Dr. Carpenter and his coadjutors. From this we learn that, while some genera range through a number of epochs, others are confined to a single formation only, as *Fabularia*, *Acicularia* and *Ovulites* to the Tertiaries; *Cuneolina* to the Chalk; and *Fusulina* (the most remarkable of all the extinct forms of Foraminifera), to the Carboniferous Limestone.

CHRONOLOGICAL ARRANGEMENT OF FORAMINIFERA.

NAMES OF FAMILIES AND GENERA.	NAMES OF PERIODS.					
	Paleo-zoic.	Triassic.	Juras-sic.	Creta-ceous.	Terti-ary.	Recent.
Gromida	. .	. .	. .	. .	. .	—
Miliolida	. .	—	—	—	—	—
Squamulina	. .	. .	. .	. .	. .	—
Cornuspira	. .	. .	. .	. .	—	—
Nubecularia	. .	—	—	?	—	—
Vertebralina	. .	. .	. .	. .	—	—
Miliola	. .	. .	—	—	—	—
Fabularia	. .	. .	. .	. .	—	. .
Peneroplis	. .	. .	. .	. .	—	—
Orbiculina	. .	. .	. .	. .	—	—
Alveolina	. .	. .	. .	?	—	—
Orbitolites	. .	. .	. .	—	—	—
Dactylopora	. .	. .	. .	. .	—	—
Acicularia	. .	. .	. .	. .	—	. .
Lituolida	—	—	—	—	—	—
Trochammina	—	?	—	—	—	—
Lituola	. .	—	—	—	—	—
Valvulina	. .	. .	. .	—	—	—
Lagenida	—	—	—	—	—	—
Lagena	. .	. .	. .	—	—	—
Nodosarina	—	—	—	—	—	—
Orthocerina	. .	. .	—	—	—	—
Polymorphina	. .	—	?	—	—	—
Uvigerina	. .	. .	. .	. .	—	—
Globigerinida	—	—	—	—	—	—
Orbulina	. .	. .	. .	. .	—	—
Ovulites	. .	. .	. .	. .	—	. .
Spirillina	. .	. .	. .	. .	—	—
Globigerina	. .	. .	. .	—	—	—
Pullenia	. .	. .	. .	—	—	—
Sphæroidina	. .	. .	. .	—	—	—
Carpenteria	. .	. .	?	?	. .	—
Textularia	—	. .	?	—	—	—
Chrysadilina	. .	. .	. .	—	. .	—
Cuneolina	. .	. .	. .	—	. .	. .
Bulimina	. .	—	—	—	—	—
Cassidulina	. .	. .	. .	. .	—	—
Discorbina	. .	. .	. .	—	—	—
Planorbulina	. .	. .	—	—	—	—
Pulvinulina	. .	—	—	—	—	—
Rotalia	. .	. .	. .	—	—	—
Cymbalopora	. .	. .	. .	—	. .	—
Calcarina	. .	. .	. .	—	—	—
Tinoporus	. .	. .	. .	—	—	—
Patellina	. .	. .	. .	—	—	—
Polytrema	. .	. .	. .	. .	. .	—
Nummulinida	—	. .	. .	—	—	—
Amphistegina	. .	. .	. .	. .	—	—
Operculina	. .	. .	. .	—	—	—
Nummulina	. .	. .	. .	. .	—	—
Polystomella	. .	. .	. .	—	—	—
Heterostegina	. .	. .	. .	. .	—	—
Cycloclypeus	. .	. .	. .	. .	—	—
Orbitoides	. .	. .	. .	—	—	. .
Fusulina	—	. .	. .	. .	. .	. .

The affinities of *Fusulina* are still uncertain, but supposing it removed from its present place among the *Nummulinida*, it might then be said that this family first appears in the cretaceous formations, suddenly undergoes a high development in the tertiaries, and in existing seas shows itself on a less conspicuous scale. While the recent genus *Cymbalopora*, though found also among the fossils of the chalk, has not yet been detected in tertiary deposits. The *Miliolida* appear to be absent from Paleozoic rocks. Two genera of calcareous Foraminifera, together with the family of *Gromida* are wholly recent. The remaining families *Globigerinida*, *Lagenida*, and *Lituolida*, appear to have flourished in all seas, from those of the lower Palæozoic to the present day.

The remarkable continuity in time between the leading types of Foraminifera, with the general conclusions deducible from this and other great facts in their geological history, having, on a former occasion* been laid before us by Dr. Carpenter himself, it is not necessary that we should once more repeat them.

And so we bring to a close our notice of this Monograph, thanking the author for its contents, and the Index which we hope to use in again referring to them. In the companion Monographs of Professors Allman and Huxley, we have felt more than once the loss of an Alphabetical Index and Table of Contents.

The twenty-two lithographic illustrations at the end of the volume have been very carefully executed by Mr. George West. Most of the drawings which these plates contain represent Dr. Carpenter's original sections and preparations. With a view, however, to give completeness to his work, he has added some figures of importance from the writings of Schultze, Müller, Ehrenberg, and others. Woodcuts, also, are scattered through the text.

A word, in conclusion, for the Ray Society. As one of the subscribers to that body (with which in no other way is he connected) the writer of the present notice thinks it but just to state, that in Dr. Carpenter's Monograph he has received a full return for his subscription. Comparing it with Schultze's well-known essay on the Polythalamia, a work very closely resembling it in scope, he finds in the English monograph 320 pages and 22 plates, in the German 68 pages and 7 plates. Schultze's work has been published, by the enterprising house of Engelmann, at 8 thalers (24 shillings), while Dr. Carpenter's has cost the members of the Ray Society only one guinea. This is certainly a most satisfactory result. Surely then it is for all to aid the Council of the Ray Society. In hope we sit and wait for their two forth-coming volumes, which, after unavoidable delays, will soon appear, and crown with well-deserved success their energetic management.

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* See Natural History Review, April, 1861, pp. 196—201.

XXXIV.—CONTRIBUTIONS TO THE NATURAL HISTORY OF THE UNITED STATES OF NORTH AMERICA. By Louis Agassiz. Vol. IV. Boston, 1862.

THE fourth volume of Professor Agassiz' 'Contributions' has now, for some months, been on our table; and we proceed, according to promise, to lay some account of its contents before our readers.

It will be remembered that the preceding volume* of the same work contained the two first parts of the Author's 'Second Monograph,' which treats of the Acalephs. These parts were entitled 'ACALEPHS IN GENERAL,' and 'CTENOPHORÆ.' In the present volume this monograph is continued and, apparently, brought to a conclusion, though Professor Agassiz speaks, more than once, of resuming the discussion of portions of its subject-matter on a future occasion.

The bulk of the volume is engrossed by Parts III. and IV., on the 'DISCOPHORÆ' and 'HYDROIDÆ,' these, with the CTENOPHORÆ, forming the three orders into which, according to Professor Agassiz, the class Acalephæ should be divided. Nearly 400 pages of text and 17 plates are thus occupied; to which should be added 23 (out of the 26) plates in Vol. III. which refer solely to the *Discophoræ* and *Hydroidæ*. Lastly, there is here a fifth, and much smaller Part, on the 'HOMOLOGIES OF THE RADIATA.'

We have seen that the class of Acalephs, as thus extended and revised, includes the *Acalephæ* of Eschscholtz, together with the *Hydroida* and *Lucernariadæ* of Johnston. Both Johnston and Milne Edwards have associated the last mentioned family with the Actinoid Polypes. Except as to this particular (and another, to be presently stated), the *Acalephæ* of Milne Edwards and Agassiz, in their entirety, correspond, though there is not quite the same accordance between these two eminent naturalists, both, it must be remembered, original investigators of the most varied typical forms belonging to the group, as to what ought to be considered its primary divisions. This will appear from the accompanying table.

ACALEPHS. AGASSIZ.	ACALÈPHES. MILNE EDWARDS.
Order 1. Hydroidæ . . .	Classe 1. Hydraires.
,, 2. Discophoræ	,, 2. Siphonophores.
,, 3. Ctenophoræ . . .	,, 3. Médusaires.

The order *Hydroidæ* of Agassiz is even more extensive than the above comparison would seem to imply, for, besides the *Hydroida* of Johnston and *Siphonophoræ* of Eschscholtz, it contains most of the *Discophoræ* referred by the latter naturalist to his second section, *Cryptocarpæ*, in addition to the Tabulate, Tubulose and Rugose Corals, placed by all other systematists among the *Polypi*.

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* Noticed in Natural History Review, October, 1861.

Save in so far as they include these coral forms, the orders *Discophoræ* and *Hydroidæ* of Agassiz correspond, collectively, to the class *Hydrozoa*, as extended in 1856 by Huxley. So that this fourth volume of his 'Contributions,' like the 'Oceanic Hydrozoa' of our colleague, has some claim to be regarded as a manual of the class in question. The differences between these two works are, indeed, striking enough; their points of agreement less obvious. Nevertheless, both are abundantly stored with original observations, but contain also much general comment and discussion of first principles. Both, therefore, are indispensable, as books of reference, to the working student. Again, while Professor Huxley's work embraces a detailed account of the *Siphonophora*, the remaining orders of *Hydrozoa* (if we except such reference as is made to them in his 'General Introduction') being passed over, we find these very orders most fully treated by Professor Agassiz, whose remarks on the *Siphonophora* are limited to a few pages.* So that the two monographs, in matters of fact as well as in matters of opinion, serve to supplement and render each other complete.

So much, then, for the volume as a whole. Next, of its separate divisions, foremost among which comes Part III.:—on the *Discophoræ*.

In his opening pages Professor Agassiz brings forward certain views on the limits of the order in question, acknowledging all the extensions which it has recently received, and proposing to enlarge its boundaries yet further. We deem it right to direct attention more fully to this subject, as a department of systematic zoology instructive and interesting in its details, of which we would here present as brief and complete a *resumé* as possible. And to do so the more profitably we shall adopt the simply historical mode of statement, which will be for our present purpose, at once the most popular and the most intelligible.

Linneus, the founder of genera, formed the genus *Medusa* for the reception of all the oceanic cœlenterate animals with which he was acquainted. About the same time, Patrick Brown† proposed the name of *Beroë* for one of these forms, which Linneus first associated with *Medusa*, and afterwards with *Volvox*, while O. F. Müller, Modeer, and others regarded it as truly generic. Towards the close of the last and commencement of the present century, we find both *Beroë* and *Medusa* enriched by the discovery of numerous additional species, soon in their turn to become genera, and even families, the names of which are brought together in the systematic works of contemporary writers, especially of Cuvier and

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* We might extend this comparison by remarking that Professor Huxley's observations were made chiefly in the Southern, those of Professor Agassiz in the Northern Hemisphere; while the work of the one was published on the Eastern, that of the other on the Western shore of the Atlantic.

† The Civil and Natural History of Jamaica, 1756.

Lamarck. These two distinguished men fell short, perhaps, of what might have been expected from them in their attempts to group in a natural manner the organisms thus accumulated, a task the successful accomplishment of which was reserved for Eschscholtz. This zoologist, in 1829,* raised *Medusa* and *Beroë*, with their respective allies, to the rank of orders, *Discophoræ* and *Ctenophoræ*, which with a third order, *Siphonæphoræ* (including *Porpita*, *Velella* and the *Acalephæ hydrostatich* of Cuvier), formed the revised class of *Acalephæ*. The *Discophoræ* were arranged under two sections, *Cryptocarpæ* and *Phanerocarpæ*. All competent investigators, who, since Eschscholtz, have busied themselves with these Acalephs, bear testimony alike to his sagacity and extensive practical knowledge of a group of animals, then little studied or cared for, and whose mutual relations he so successfully sought to unfold. And the two divisions of *Discophoræ* which he proposed have, in substance, been adopted by most zoologists, though the names given to them have more than once undergone alteration.

Edward Forbes,† referring to the fact that the reproductive organs of the *Cryptocarpæ* were by no means so inconspicuous as their name would seem to imply, designated this sub-order *Gymnophthalmata*. The *Phanerocarpæ* were termed *Steganophthalmata*, because in them, the supposed eyes around the margin of the swimming disc were protected by hood-like coverings. We shall, however, see that differences in the position of their generative organs constitute the best marks of distinction between these two groups, while the character on which Forbes so strongly insisted fails.

This latter fact was very clearly pointed out by Gegenbaur who, in 1857, published the best paper on the discoid Medusæ which had up to that time appeared.‡ For in some genuine *Phanerocarpæ* no hoods, in others no eye-specks are present, and in certain 'Naked-eyed *Medusæ*' all trace of "eyes," or other marginal bodies, seem wanting.|| Gegenbaur noted further that all *Cryptocarpæ* were furnished with a veil-like projection around the margin of the bell, while in those *Phanerocarpæ* which he examined such a structure was not discoverable. For these, therefore, he suggested the name of Acraspeda; the *Cryptocarpæ*, or naked-eyed *Medusæ*, being designated Craspedota. He also removed from this section the *Oceania marsupialis*§ of Eschscholtz (*Charybdea marsupialis*, Péron et Lesueur), to constitute, under the name *Charybdeidæ*, the fourth family of his Acraspeda. And

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* *System der Acalephen*, published a year before the third volume of the second edition of Cuvier's Règne Animal, in which the Acalephæ are systematised.

† A Monograph of the British Naked-eyed Medusæ, 1848.

‡ Versuch eines Systemes der Medusen, mit Beschreibung neuer oder wenig bekannter Formen; zugleich ein Beitrag zur Kenntniss der Fauna des Mittelmeeres. Siebold und Kölliker's Zeitschrift, Band VIII.

|| Gegenbaur, op. cit. p. 207.

§ A very remarkable Medusa, figured in 1739 by Plancus. Its specific name originated with Linneus. In 1833 it was made the subject of an elaborate essay by Milne Edwards (Ann. S. N., XXVIII).

he directed attention, in a marked manner, to the striking peculiarities of the *Æginidæ*, a group of naked-eyed *Medusæ* at that time imperfectly appreciated.

Meanwhile the development of the *Discophoræ* was being successfully investigated by a number of able observers, and, among other singular phenomena thus brought to light, it appeared that many of the *Cryptocarpæ* were but the free-swimming reproductive buds of various fixed Hydroids and Siphonophora. It was shown also, alike by the method of gradations and the test of development, that the structure of these highly specialized zoöids passed by imperceptible degrees into that of other fixed and lower organized generative bodies belonging to different members of the same groups.

With regard to the *Phanerocarpæ*, it was proved that some, at least, of these creatures resulted from the transverse fission of asexual, hydraform larvæ, or rather protozoöids, very minute in size compared with their large free-swimming reproductive bodies, but, though less complex, decidedly resembling them in structure. The ova of these zoöids, when fertilised, become developed into 'Hydra-tubæ,' which again, by fission, produce "jelly-fishes."

The Hydra-tubæ, both in form and organisation, also closely resemble the marine animals referred by O. F. Müller to the genus *Lucernaria* (family *Lucernariadæ* of Johnston). This view of the near affinities of the *Lucernariæ* was, in 1856,* distinctly enunciated by Huxley. It is true that, at an earlier date, they had been placed, conjecturally, in the neighbourhood of the *Medusæ*, but most naturalists still continued to associate them with the Sea-Anemones. Huxley, however, went so far as to unite the *Lucernariæ* and *Phanerocarpæ* into one order, which he at once termed *Lucernaridæ*. The Craspedota he divided, potentially, into two groups: viz. (1), free reproductive zoöids of other orders of *Hydrozoa*, and, therefore, rightly referrible to such orders; and (2), those "developed directly from the eggs of similar organisms." The existence of these last he regarded as probable, not proven. For their reception, as also for that of those Craspedota "with whose origin we are unacquainted," he established a provisional order, *Medusidæ*.†

But Kölliker, in 1853,‡ relying chiefly on the observed differences between their modes of development, had separated the *Cryptocarpæ* from the higher *Discophoræ*, a term which he restricted to the *Phanerocarpæ* or *Steganophthalmata*.||

We come at length to the views of Professor Agassiz, as expressed in the volume before us. The *Discophoræ*, in his opinion, constitute one of the three orders of the class *Acalephæ* in its widest sense (the

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* Lectures on General Natural History, (Lecture IV.) Medical Times and Gazette, June 7.

† The Oceanic Hydrozoa, 1859; p. 21.

‡ Die Schwimmpolypen oder Siphonophoren von Messina, p. 77.

|| Leuckart goes further than this, and even uses the word *Acalephæ* as a synonym of *Phanerocarpæ* (See his Bericht in Wiegm. Arch.).

names of the other orders having been mentioned above) and include—

a. the *Discophoræ* of Kölliker,
b. the *Charybdeidæ* of Gegenbaur,
c. the *Lucernariadæ* of Johnston, and
d. the family *Æginidæ.*

The question, therefore, as to the systematic value of the structural differences between the *Phanerocarpæ* and *Cryptocarpæ* resolves itself into a discussion concerning the position of the two doubtful families, *Charybdeidæ* and *Æginidæ.* To place this in a stronger light let us remove these families, provisionally, from the order *Discophoræ*, Esch., and, this being done, contrast its primary sections with one another.

In the *Cryptocarpæ,* thus limited, the margin of the swimming-bell is entire, and always furnished with a 'veil.' The radiating canals, which never anastomose, open into a circular marginal vessel. The reproductive organs are situate, either within the walls of the digestive appendage (polypite) depending from the roof of the bell, or along the course of its radiating vessels; never on the floor of the central cavity whence these originate. Their contents, when developed, escape directly into the surrounding medium. The naked marginal bodies, sessile at the bases of the tentacles, or placed (rarely on stalks)* in the interspaces between them, have no communication with the canal system.

In the *Phanerocarpæ* the margin of the disc is always indented, and a veil is often absent. A veil-like structure, however, exists in the common jelly-fish *(Aurelia)*, so that the character selected by Gegenbaur to distinguish more accurately this group from the *Cryptocarpæ* is of no avail. Still less can we seek to separate the two divisions by referring to the more depressed disc, numerous radiating canals, and comparatively short oral apparatus,† characteristic of most (though not all) *Phanerocarpæ.* For some of the *Cryptocarpæ*‡ will be found to rival them in each of these particulars. But all *Phanerocarpæ* differ strikingly from the *Cryptocarpæ* in the structural relations both of their reproductive organs and marginal bodies. The former are developed within sac-like depressions, or processes, of the floor of the central cavity, into which the ova or spermatozoa are discharged. The marginal bodies, which never present themselves at the bases of the tentacles, are placed at the free extremities of hollow stalks, each containing a cœcal prolongation of the neighbouring radial vessel. Beyond this process lies a minute sac, the prismatic contents of which, unlike the concretions of the *Gymnophthalmata*, are not soluble in acetic acid. These 'lithocysts' may or may not be furnished with pigment-spots,* and their protection by hoods, though frequent, is not invariable. Lastly, within the central cavity, in the neighbourhood of the reproductive organs, are situated groups of peculiar solid filaments, the 'generative (or gastric) tentacles,' not, as yet, noted in the lower *Medusæ*.

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* This is, however, the case with the *Tiaropsis diademata* of Agassiz, the marginal bodies of which are described at page 308 of the present volume.

† The structure of this apparatus, with its four stout pillar-like angles, radiating proximately along the floor of the common cavity, is, however, as Professor Agassiz here reminds us, a true distinctive feature of the higher *Medusæ.*

‡ For example, certain *Æquoridæ.* See the account by Forbes of a large British species of this genus in Zoöl. Proc., 1851.

We agree, therefore, with Professor Agassiz when he states "that neither the presence nor the absence of a veil around the margin of their disk, upon which Gegenbaur has based his division of the Craspedota and Acraspeda, neither the exposed nor the protected position of the marginal eye-specks, which Forbes took as a basis for the separation of the Steganophthalmata and Gymnophthalmata, nor the development of the ovaries and spermaries, upon which Eschscholtz founded his sub-divisions of the Phanerocarpæ and Cryptocarpæ truly mark the limit between the primary subdivisions which ought to be admitted among the Discophoræ." And we think that he has rightly directed prominent attention to the very different relations of their reproductive organs. "Had not the discovery of their presence obliterated the distinction made by Eschscholtz, it would have been remembered that in the Phanerocarpæ the ovaries as well as the spermaries are complicated organs, contained in distinct pouches communicating directly with the main cavity of the body and discharging their eggs into that cavity and then through the mouth; while in the Cryptocarpæ they consist only of folds along the course of the chymiferous tubes or upon the sides of the proboscis, and discharging their eggs immediately into the surrounding medium, but never through the main cavity and the mouth." But, though looking on this structural distinction as one of ordinal value, he is by no means disposed to exaggerate it, for, as he reminds us in the closing paragraph of his first section, there is "the closest homology" between the reproductive organs of both groups, "for the large pouches containing the ovaries and spermaries of the Phanerocarpæ are, after all, only dilatations of the chymiferous system along the course of its radiating channels; while in Cryptocarpæ, instead of large pouches there are simple, narrow tubes, upon the sides of which the eggs are developed, and from which they immediately drop into the surrounding medium. The fact, that in some Cryptocarpæ the eggs are developed upon the proboscis, in no way conflicts with this explanation, since the angles of the proboscis, as may best be seen in *Bougainvillea*, are quite as much the direct prolongation of the radiating tubes, as the ovarian pouches of *Cyanæa* are a direct prolongation of its radiating chymiferous sacs."

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* The *Oceania turrita* of Forbes, cited by Gegenbaur (op. s. cit.) as the only example of a Naked-eyed Medusa in which vesicles and pigment-spots co-exist, has both kinds of these bodies situate at the bases of the four tentacles, between each pair of which are "three yellowish marginal tubercles, with rudimentary ocelli." This species does not appear to have been examined since Forbes first discovered it in 1845. See his Monograph, p. 28.

In his comparison of the marginal bodies of both sections, Professor Agassiz seems, notwithstanding, to have forgotten the peculiar nature of their contents in the higher *Medusæ*, together with the fact, that their supporting stalks received cœcal processes from the canal system. This character they share in common with *Charybdæa marsupialis*, type of the *Charybdeidæ* of Gegenbaur,* to whom and to Fritz Müller, a German naturalist pursuing his investigations on the shores of Brazil, we are much indebted for the most recent and valuable additions to our scanty knowledge of this very interesting family. To the last mentioned observer,† our thanks are more particularly due, and we would dwell for a moment on the somewhat striking coincidence that the very question at present under consideration should simultaneously have engaged the attention of two European naturalists, both making use of their own original materials, both residents on the great American continent, the one in its Northern, the other in its Southern division, and working, therefore, quite independently of one another.

The swimming-bell of the *Charybdeidæ* has its convex surface supplied with deep radiating furrows, and clefts in which the four marginal bodies are lodged. In one genus, *Tamoya*, a distinct veil is present. The oral proboscis (polypite) is more like that of the *Cryptocarpæ* than that of the higher *Medusæ*, but, as in the latter, the central cavity within the substance of the bell is furnished with the peculiar filaments before referred to. These are not, however, situate in the immediate neighbourhood of the reproductive organs, which are lodged in large lateral pouches of the central cavity. The pouches may or may not be further produced into canals. There is no circular vessel. The tentacles are distant from the margin, being borne at the free ends of large characteristic processes which, in some cases, replace them altogether. The marginal bodies resemble those of the *Phanerocarpæ*.

The *Æginidæ* appear to lead from the *Charybdeidæ* to the lower *Medusæ*, differing from the latter in most of the characters which distinguish the former. Their reproductive organs are developed within similar pouches, but 'generative tentacles' have not as yet been detected. There is no proper canal system. The disc is emarginate,‡ furrowed, and furnished with a veil. The tentacles arise from the convex surface of the bell, at some distance from its margin. The marginal bodies are usually stalked, but in their contents are said to resemble the 'vesicles' of the *Cryptocarpæ*.

It must be admitted, therefore, that some facts support the proposition of Fritz Müller, to unite the *Charybdeidæ* and *Æginidæ* into a group* by themselves, morphologically equivalent to the *Phanerocarpæ*, and intermediate between them and the lower *Medusæ* (with their Hydroid allies). The members of such a group would at least agree: (1) in their lateral reproductive pouches; (2) in their dorsally furrowed bell, with its tentacles remote from the margin; and (3) in the absence of a circular vessel. But the position of their reproductive organs, though intermediate, in some degree, between what we find in the two sections of *Discophoræ*, Eschsch., respectively, approximates these forms more nearly to the higher *Medusæ*, among which, likewise, their much modified canal system, and particularly the absence of a circular vessel may be paralleled. On the other hand, in all *Cryptocarpæ* this vessel occurs, and communicates with the central cavity by narrow radiating canals. In the *Cryptocarpæ*, also, the tentacles, when present, are strictly marginal, but it is otherwise with many of the higher *Medusæ*. Even Fritz Müller himself acknowledges that the *Charybdeidæ* are more closely related to the latter than to the former, and that, if the old binary division of Discoid *Medusæ* be retained, "the *Charybdeidæ* can only find their place among the higher *Discophoræ*, with which they have in common at least the gastric filaments and the insoluble contents of the marginal bodies."

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* See his essay on the Marginal Bodies of the Medusæ in Müller's Archiv., 1856.

† We refer especially to his memoirs, 'Die Magenfäden der Quallen,' Z. W. Z. IX. 1858, p. 542; 'Zwei neue Quallen [*Tamoya*] von Santa Catharina (Brasilien).' Halle Abh. V. 1859; and 'Ueber die systematische Stellung der Charybdeiden,' Wiegm. Arch. XXVII. 1861, p. 302.

‡ A fact denied by Gegenbaur, but re-asserted by Fritz Müller.

Thus, with reference to the systematic position of the two families in question, four separate opinions have been held, viz.:—

1. That of Eschscholtz, who refers both to his *Cryptocarpæ*.
2. That of Agassiz, who places both with the *Phanerocarpæ*.
3. That of Gegenbaur, who transfers the *Charybdeidæ* to the *Phanerocarpæ*, leaving the *Æginidæ* with the lower *Medusæ*.
4. That of Fritz Müller, who unites both families into one group, intermediate between the Hydroid *Medusæ* and *Phanerocarpæ*.

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* Fritz Müller's entire arrangement is as follows:—

HYDROMEDUSÆ.

1. SIPHONOPHORA, together with their free reproductive zoöids.
2. HYDROIDA.
    - *a. Tubularina*, and the Hydroid Medusæ without organs of sense or with eye-specks.
    - *b. Sertularina*, and the Hydroid Medusæ with marginal vesicles.

    In relation to development this group includes:
    - *a*) Polypites without free reproductive zoöids.
    - *β*) Polypites with free reproductive zoöids.
    - *γ*) Free sexual animals without polypites, (Trachynema, Liriope).
3. ACALEPHÆ, R. Lt. (Discophoræ Phanerocarpæ, Eschsch.).
    - *a. Monostome* (Medusidæ, Eschsch.).
    - *b. Polystome* (Rhizostomidæ, Eschsch.).
4. ÆGINOIDA (Ægineæ, Lütk.).
    - *a. Lower.* Cunina (Ægina rosea, Eschsch.); Ægineta; Polyxenia; Æginopsis bitentaculata.
    - *b. Higher, Charybdeidæ.* Æginopsis Laurentii (?); Ægina (citrea); Charybdea (marsupialis); Tamoya; Periphylla (Ch. periphylla, Pér.).

Save in its recognition of the "*Æginoida*" as a primary division, this classification of the *Hydromedusæ* closely agrees with that of R. Leuckart.

Which of these diverse views should be adopted? The choice perhaps lies between those of Professors Gegenbaur and Agassiz, and we feel on the whole disposed to give in our adherence to the latter, and to unite into one order the *Phanerocarpæ*, *Charybdeidæ*, *Æginidæ* and *Lucernariadæ*. And for such a group the name* which Professor Agassiz has reserved appears sufficiently suitable, should we hesitate to adopt the still older designation of *Medusæ*.† As to the *Lucernariadæ*, their close structural resemblance to the zoöids of the hydra-tuba stock, from which the more common free-swimming *Phanerocarpæ* are produced, together with the fact that, like the latter and the *Charybdeidæ*, they possess the 'gastric filaments' of which we have already spoken, must remove almost all doubts as to their true affinities.

What, however, is to be done with the *Cryptocarpæ* proper? Such of these as have been proved to be zoöids must of course be relegated to the forms whence they originate. But there still remain behind *Cryptocarpæ* of uncertain origin, along with those which undergo direct development. So long, indeed, as the *Æginidæ* were retained in this division, it was possible to indicate two well-marked sections of the lower *Medusæ*, founded on structural characters, which appeared to be correlated with others derived from supposed differences in their modes of development; the *Æginidæ* being the direct produce of fertilized eggs, while the remaining *Cryptocarpæ* were presumably zoöids. But the *Æginidæ* have now been removed, while doubts suggest themselves as to the zoöid nature of, at least, three of the ordinary *Cryptocarpæ*.‡ No one, however, regards the structural characters of such directly-developed *Cryptocarpæ* as in themselves of ordinal value. And their different mode of origin is surely insufficient for this purpose. We do not place *Pelagia* apart from the other *Phanerocarpæ*, because a hydra-tuba stage is wanting in its development. And in various orders of animals, for example, the *Trematoda*, there are some forms which exhibit a singular metagenesis, while in others such phenomena do not occur. We are, therefore, disposed to side with Fritz Müller and Agassiz in their proposal to abolish the *Cryptocarpæ* as a separate group, its several members taking their rank next those undoubted zoöids which in structure they most closely resemble.

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* In the best systematic work on the Annelids, that of Grube, the name *Discophora* is given to the Leeches and their allies (*Hirudinea*). But this change in the use of a well established term is decidedly open to objection.

† Or *Medusida*. The restriction of this term, by Eschscholtz, to the Monostome *Phanerocarpæ*, and by Huxley to the *Cryptocarpæ*, has led in practice to some confusion. The genus *Medusa* of Linnæus (last ed. of Syst. Nat.) may fairly be taken as a synonym of *Discophoræ*, Eschsch. And though this group has been at once diminished (by the removal of some *Cryptocarpæ*) and increased (by the addition of the *Lucernariadæ*) it still preserves so large a portion of its original contents as to remain, fundamentally, the same. Apart from historical considerations the name *Lucernaridæ* (Huxley) would be a good one for this order, but is liable to be confounded with *Lucernariadæ*, one of its families.

‡ See the place assigned to these in the arrangement, already quoted, of Fritz Müller.

According, therefore, to the views now here laid down, the proper value of the primary divisions of *Hydrozoa* will be as follows:—

Class HYDROZOA.

Sub-classes.	Orders.
I. Hydroida, Johnst.	1. *Hydrida.*
	2. *Tubularida* or *Corynida.*
	3. *Sertularida.*
II. Siphonophora, Eschsch.	4. *Calycophorida.*
	5. *Physophorida.*
III. Discophora, Eschsch.	6. *Medusida.* Lucernaridæ. Æginidæ. Charybdeidæ. Monostomidæ. Rhizostomidæ.

Excepting its introductory chapter, which we have noticed at so much length, Part III. essentially includes—

1. Original observations on various North American forms belonging to the order.
2. Critical remarks on other forms more or less closely allied to these.
3. A "Tabular view of the Discophoræ known at present," and
4. A short section on the Geographical Distribution of the Discophoræ.

The original observations have reference to the following species:—

a. *Aurelia flavidula.*
b. *Cyanæa arctica.*
c. *Pelagia cyanella.*
d. *Stomolophus meleagris.*
e. *Polyclonia frondosa.*

The first two of these, more particularly *Aurelia*, are described with very great minuteness of detail, the majority of the beautiful plates in Vol. III. being devoted to their representation. These two *Medusæ*, in their free sexual state so dissimilar, are, it is well known, wonderfully alike in their polypoid or hydra-tuba stage. Professor Agassiz has taken considerable pains not to confound these two kinds of hydra-tubæ with one another. We would almost go so far as to say that his plates have a greater value than his descriptions, though both taken together illustrate the structure and development of the higher *Medusæ* in a more complete manner than any other monograph yet published. It is indeed true that, by combining and correcting the several essays of Sars, Siebold, Ehrenberg, and a number of other observers, most of the information which

Professor Agassiz has here given might be obtained. All this we may admit, and still attach a high value to the copious record of independent investigations now before us.

a.—*Aurelia flavidula* so nearly resembles its European congener, *A. aurita*, that the specific distinctness of the two appears to us by no means proven. This, the commonest of all "jelly-fishes," though not a stinging species, is, at the same time, rather an aberrant than a typical member of its group. Its marginal tentacles, veil-like membrane, and circular canal, in possessing which it differs from the majority of *Phanerocarpæ*, are so many points in which it agrees with the lower *Medusæ*. On the other hand, according to Professor Agassiz, very old specimens of *Aurelia* show some degree of approximation, however remote, to the *Rhizostomidæ*. The Hydra-tuba observed by Reid belongs to this genus, but Professor Agassiz asserts that the canal-system, described by that anatomist, does not really exist, its four radiating elements being solid longitudinal ridges (long before noticed as such by Siebold), while the circular vessel is wanting. The canal-system of the mature *Aurelia* Professor Agassiz describes with a view to his own theory of the homologies of its parts. It is usual to recognize sixteen canals, starting from the central cavity, of which eight run, without branching, to points on the circular vessel, midway between the marginal bodies, while each of the eight other canals supplying these last gives off, close to its origin, a pair of vessels which again and again sub-divide on their way to the margin, the branches thus formed becoming reconnected by anastomosis.* Professor Agassiz, however, regards the radiating canals as consisting of eight different systems; namely, four simple, or "ambulacral," and four more complex "interambulacral" systems. It must be remembered that the four extensions of the central cavity which constitute the genital chambers alternate with the oral appendages and with four of the (eight) marginal bodies. Now, the four ambulacral systems are those which issue directly from the central cavity and correspond, therefore, with the four mouth corners; while the interambulacral systems appear to arise from the outer edges of the genital pouches between them.

> "From each corner of the mouth, and between two adjoining genital pouches, arises one main radiating tube, extending straight to one of the marginal indentations, without lateral ramifications, except from near its base, on each side of which arises one branch which divides again and again, anastomosing among themselves. Of such systems there are, normally, only four."
>
> "The systems which correspond to the radial prolongations of the genital pouches are far more complicated: in the first place, the sexual pouch itself must be considered as a sack-like enlargement of this radiating system, and from the outer wall of this sack arise the peripheric radiating tubes belonging to it, three of which are simple, and extend directly to the margin without ramifications. The central one extends from the middle of each genital pouch to the corresponding marginal indentation; the outer ones, bordering each genital system, arise independently near

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* See the drawing by Milne Edwards, in his "Récherches anatomiques et zoologiques faites pendant un voyage sur les côtes de la Sicile."

the outer angles of the genital pouches, and between these three simple tubes, arise further, from the peripheric edge of the genital pouch, one or two branching radiating tubes, the branches of which anastomose with one another. There is less regularity in the ramifications of these tubes, than of those which correspond to the angles of the mouth, not only in their mode of ramification, but also in their origin."

Where the eight simple canals which supply the margin, at points equidistant but remote from its sensitive bodies, (or, in other words, the lateral elements of Professor Agassiz' interambulacral systems) join the circular vessel, Ehrenberg, as naturalists are aware, indicated the presence of what he believed to be excretory apertures, and, certainly, pellets of *rejectamenta* may often be met with at these parts of the animal. Professor Agassiz denies the existence of the openings in question.

"The lumen of these simple tubes being somewhat larger than that of the adjoining branching tubes, their anastomoses with the marginal tubes constitute somewhat wider spaces, in which occasionally an accumulation of undigested minute particles may be observed; but these are always after a while carried along with the circulation, and are brought back to the central cavity in the returning currents, and finally rejected through the oral aperture."

Interesting particulars are also given as to the minute structure of the marginal bodies, the thread-cells, and the disc itself. On all these subjects Professor Agassiz has largely availed himself of the researches of his able coadjutor, Professor H. J. Clark.

A second species of *Aurelia*, *A. marginalis*, has been observed by our author on the coasts of the Southern States. It has very large genital pouches, and is, absolutely, of greater size than *A. flavidula*, "specimens exceeding one foot in diameter being quite common. The genital organs are constantly of a pale rose-coloured tint on both sides."

b.—The two common stinging jelly-fishes of the British coasts, *Cyanæa capillata* and *C. Lamarckii*, are represented along the opposite shores of the Atlantic by the nearly allied, if not identical, species *C. arctica* and *C. versicolor*, respectively. Brief reference is made to a third North American Atlantic species, *C. fulva*, which differs from the two just mentioned, as do these from one another, in geographical distribution.

The detailed notice of *Cyanæa arctica* here given derives its chief value from the minute account which it includes of the precise form of the disc, and of the various markings observable on its lower surface. In describing these Professor Agassiz falls into just admiration of the skilful manner in which they have been represented by his artist, Mr. Sonrel. Further observations are yet wanting on those first states of the free *Cyanæa* which immediately succeed its hydra-tuba condition. Professor Agassiz supposes "that during the early stages of their existence they remain near the bottom of the water, as they are very seldom seen floating near the surface." In this connexion he describes a very young specimen, only half-an-inch in diameter, observed by his son in Buzzard's Bay.

c.—"*Pelagia cyanella* has already been accurately described by Eschscholtz, but a figure with details of its structure was still wanted," and Professor Agassiz has here "attempted to supply the deficiency." The single specimen which he observed at the Tortugas Islands, in the Gulf of Mexico, happily afforded him an opportunity of tracing, for five days, its early development, and his account of this, so far as it goes, is valuable, as tending to corroborate the fuller observations of Krohn on the European *P. noctiluca*. In neither of those species is a hydra-tuba stage noticeable. The young is directly developed, and is, at all periods of its existence, free swimming.

d. e.—The two remaining species of North American *Discophoræ* here noted belong to the *Rhizostomidæ*. The very remarkable polystomism of these *Medusæ* Professor Agassiz, as we have before hinted, explains by referring to those changes which take place, with increase of age, in the genus *Aurelia* :—

> "As Aurelia grows older, the arms become thicker along their centre, and the thin margins are folded against one another, their edge alone remaining pliable upon the sides of the stiffer axis; but as these edges are themselves wider, longer, and more spreading than the axis, they fold, bend, and twist in every direction, from both sides, until, at last, these winding folds become also harder and stiffer, and can neither be fully opened nor stretched, so that, though the margin of the arms is free and open, from tip to base, and can be laid out like a flat leaf, with comparatively little effort, each arm of an adult Aurelia forms, in reality, a system of flat channels, gaping along the margin, and uniting into fewer and fewer ramifications toward the middle line of the arm, along which runs the larger channel which terminates in the mouth. The central aperture, or the mouth itself, undergoes identical changes. Its walls become thicker and stiffer, and less movable, and are finally thrown into such folds as fit one against the other so closely, that, in the end, the oral aperture is transformed into a system of capillary surfaces, between the folds of the actinostome, leading into the main cavity."
>
> "Now such is exactly the structure of a Rhizostome, with this exception only, that the margins of these capillary surfaces interlocked with one another, are soldered up, and present, only at intervals and in particular places along the edge, which vary in different genera, apertures which through life remain open and keep up a communication between the surrounding medium and the main cavity, and through which the food necessary for their sustenance is absorbed. I know, from direct observation of the young of Polyclonia frondosa, one of the earliest Rhizotomidæ known to naturalists, that in this species at least, the young has a simple funnel-shaped mouth, as widely open, as freely gaping, and as directly communicating with the central cavity of the body, as in the young Aurelia and the young Pelagia. I know, further, that in more advanced young the angles of the mouth begin to project, in the shape of arms with open and free margins, as in Aurelia, Cyanea, and Pelagia. And though I have not actually seen the margins of the mouth of any specimen of this species grow together, in such a manner as to close up the mouth, yet the fact, that in a more advanced stage of growth, specimens found together in the same shoal, and in no way differing from one another in other respects, have the margins of the arms and of the edges of the mouth so united, at intervals, that they cannot be spread out or easily opened without tearing, as well as the additional fact, that in still older specimens, not, however, exceeding one or two inches in diameter, the extent of the union of the edge of the mouth is so great, as to leave only comparatively few passages for a free communication of the surrounding medium, with the main cavity of the body, shows most unquestionably that the seeming absence of the mouth in Rhizostomeæ is only the result of a gradual closing up of the margins of the actinostome, which takes place, sooner or later, and to a greater or less extent, in different genera."

Stomolophus is a new genus, which, of all Rhizostomes, appears to come nearest to the *Monostomidæ*. Our knowledge of its single species is still very imperfect, for Professor Agassiz informs us that he has "only twice had an opportunity of seeing it, and, in both instances, under the most unfavourable circumstances."

Polyclonia frondosa is the *Medusa frondosa* of Pallas, and is identical with the *Cassiopea frondosa* of Lamarck and Eschscholtz (*not* of Tilesius). Professor Agassiz describes the structure of the mature zoöid, with the aid of two excellent plates, and notes, likewise, some interesting facts as to its habits:—

> "This Medusa is one of the most singular Acalephs I know, both on account of the different aspects it presents in different attitudes, and on account of its habits. It is quite common upon the reef of Florida; I have seen immense numbers at Key Largo and at Key West, and occasionally at other points along the reef, and yet it is hardly ever seen near the surface of the water. This is owing to its habit of groping in the coral mud, at the bottom of the water, where thousands upon thousands may be seen crowded together, almost as closely as they can be packed upon the bottom, at a depth of from six to ten feet. When disturbed they do not rise, but crawl about like creeping animals, now and then only flapping their umbrella, like other Discophoræ."

The remarks contained in the text on the mutual relations and limits of the more noticeable families and genera among the *Discophoræ* are best perused by way of commentary to the long Tabular View, in which a very complete classification of the whole order is brought forward. Its several families are therein arranged under three primary groups, or sub-orders, of which one, *Semæostomeæ*, is typical, and includes the monostome *Phanerocarpæ*. The two remaining sub-orders are aberrant, one being constituted by the *Rhizostomeæ*, while the other, *Haplostomeæ*, contains the *Charybdeidæ*, *Æginidæ* and *Lucernariadæ*. No description or figure of any American species belonging to the *Haplostomeæ* is given.

Order **DISCOPHORÆ.**

Sub-order I.—RHIZOSTOMEÆ.

Family 1.—Rhizostomidæ.

Rhizostoma, *Cuv.*
Stomolophus, *Ag.*
Stylonectes, *Ag.*
Mastigias, *Ag.*
Himantostoma, *Ag.*
Catostylus, *Ag.*
Rhacopilus, *Ag.*
Toxoclytus, *Ag.*
Melitea, *Pér. & Les.*
Thysanostoma, *Ag.*
Evagora, *Pér. & Les.*

Family 2.—Leptobrachidæ.

Leptobrachia, *Br.*

Family 3.—Cassiopeidæ.

Cassiopea, *Pér. & Les.*
Crossostoma, *Ag.*
Stomaster, *Ag.*
Holigocladodes, *Br.*

Family 4.—Cepheidæ.

Cephea, *Pér. & Les.*
Polyrhiza, *Ag.*
Diplopilus, *Ag.*
Hidroticus, *Ag.*
Cotylorhiza, *Ag.*
Phyllorhiza, *Ag.*

Family 5.—Polyclonidæ.

Polyclonia, *Br.*
Salamis, *Less.*
Homopneusis, *Less.*

Family 6.—Favonidæ.

Favonia, *Pér. & Les.*
Lymnorea, *Pér. & Les.*

Sub-order II.—SEMÆOSTOMEÆ.

Family 1.—Aurelidæ.

Aurelia, *Pér. & Les.*

Family 2.—Sthenonidæ.

Sthenonia, *Esch.*
Heccædecomma, *Br.*
Phacellophora, *Br.*

Family 3.—Cyaneidæ.

Cyanæa, *Pér. & Les.*
Stenoptycha, *Ag.*
Couthouyia, *Ag.*
Medora, *Couth.*
Patera, *Less.*
Donacostoma, *Ag.*

Family 4.—Pelagidæ.

Pelagia, *Pér. & Les.*
Placoïs, *Ag.*
Chrysaora, *Pér & Les.*
Desmonema, *Ag.*
Lobocrocis, *Ag.*
Dactylometra, *Ag.*
Polybostrycha, *Br.*
Melanaster, *Ag.*
Zygonema, *Ag.*
Nausithoë, *Köll.*

Sub-order III.—HAPLOSTOMEÆ.

Family 1.—Thalassantheæ.*

Euryale, *Pér. & Les.*
Foveolia, *Pér & Les.*
Eurybia, *Esch.*
Campanella, *De B.*
Æginopsis, *Br.*
Ægina, *Esch.*
Pegasia, *Pér. & Les.*

Family 2.—Brandtidæ.

Dodecabostrycha, *Br.*
Quoyia, *Ag.*

Family 3.—Charybdeidæ.

Charybdea, *Pér. & Les.*

Family 4.—Marsupialidæ.

Marsupialis, *Less.*
Tamoya, *Fr. Müll.*
Bursarius, *Less.*
Chiropsalmus, *Ag.*

Family 5.—Lucernariadæ.

Lucernaria, *Müll.*
Depastrum, *Gosse.*
Carduella, *Allm.*

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* Lesson's name for the *Æginidæ.*

Of the above genera nine only are really new; others which bear the name of Professor Agassiz having been formed by the sub-division or re-construction of older groups. *Stomolophus* has been already noticed, and is the only new genus of *Discophoræ* here figured. *Himantostoma*, *Hidroticus*, *Phyllorhiza*, and *Donacostoma* are from the drawings and notes of Mr. W. W. Wood, taken in the Straits of Sunda and in the China Sea. *Diplopilus*, *Couthouyia*, *Medora*, and *Zygonema* are characterized from the manuscript and figures of Mr. J. P. Couthouy (assisted by Mr. J. Drayton), "made during the exploring expedition under the command of Capt. Charles Wilkes," and "shortly to be published."

Throughout the Tabular View, Professor Agassiz, wherever possible, indicates the locality whence each species has been obtained, and, aided by such data, has drawn up the general survey of the geographical distribution of the *Discophoræ* with which Part III. terminates. He has thus been led to infer "that the lowest *Discophoræ*, the *Lucernariadæ*, are the only ones which extend to the boreal Faunæ, and that some genera, *Aurelia* and *Pelagia* for instance, are cosmopolites, while others, such as *Cyanæa* proper, are peculiar to the northern hemisphere; others are tropical, such as *Mastigias*, *Leptobrachia*, *Cephea*, *Polyrhiza*, *Diplopilus* and *Hidroticus;* others still, *Rhacopilus*, *Placoïs*, and *Lobocrocis*, are only to be found in the southern hemisphere, and many are quite local in their distribution." Thus certain zoological provinces are characterized by their own forms even of these oceanic animals, and of such Professor Agassiz points out several. Influenced by his peculiar views on the limitation of Faunæ, he is, perhaps, somewhat prone to insist on the specific differences of *Discophoræ* which other naturalists would unite and assign to wider areas, yet extensive districts still exist, the *Discophoræ* of which are little, if at all known; such as the African coasts generally, the west coast of South America, and Japan. "Among the low islands of the Pacific," in the Indian ocean, and in the Red Sea, *Rhizostomeæ* largely prevail; "a striking contrast with the western coast of North and South America, where no *Rhizostomeæ* have yet been found." To which we would add that while the pelagic *Haplostomeæ* abound in tropical and sub-tropical seas they are almost wholly replaced in northern temperate shores by their fixed allies, the *Lucernariadæ*, a group apparently wanting in tropical and southern latitudes.

(*To be continued.*)

XXXV.—ÉTUDES SUR LA VÉGÉTATION DU SUD-EST DE LA FRANCE A L'ÉPOQUE TERTIARE. Par M. le Comte G. de Saporta.—Ann. Sc. Nat. Sér. iv. xvi. 309. xvii. 191.

SUR LE RÔLE DES VÉGÉTAUX A FEUILLES CADUQUES DANS LES FLORES TERTIARES ANTÉRIEURES AU MIOCENE PROPREMENT DIT ET SPÉCIALEMENT DANS CELLE DU GYPSE D'AIX. Par le Comte G. de Saporta.—Bibliothèque Univ. et Rev. Suisse, 1863, t. xvi. livr. Mars.

FROM the newer and post-pliocene deposits to which Sir C. Lyell and Mr. Huxley have recently compelled our attention, we turn to these records of older date, which the Count de Saporta has deciphered for us. Whether it be from a greater persistence of type in the Vegetable as compared with the Animal division of organic nature, or from some other cause, we look to earlier than to pliocene pages for the clue to the solution of those problems which puzzle us most sorely, presented by the existing distribution of plants on the surface of the globe. Already we have referred, in a previous volume of this Journal, to the important bearing upon such problems which the fossil records of the Chalk and Tertiary beds possess. Pliocene and post-pliocene deposits supply some minor details of great interest it is true: for example, in the Norfolk lignites we have evidence that the spruce fir, at even their recent geological date, was an English tree, yet a comparison of the table of the species of plants of the Norfolk 'Forest-bed' with that of the associated mammalia given by Sir C. Lyell in his "Antiquity of Man" (pp. 216-7), brings out vividly the contrast between the two kingdoms to which we have alluded, in respect to the application of pliocene data to the illustration of present phenomena of plant-distribution. While all the plants, the spruce excepted, are English, and nearly all still growing wild in Norfolk, the mammalia are almost all extinct, and not only so, but many of them belong to gigantic exotic and tropical forms.

Pliocene vegetation, therefore, being so nearly identical with that now existing, we are obliged to look to earlier beds for the data which, as we anticipate, are to help us to clear up our difficulties. De Saporta, however, does not agree with us here. He holds that "... les assimilations entre les espèces fossiles et les espèces vivantes "quelque intéressantes qu'elles soient en elles-même, n'ont ni la "portée, ni la signification qu'on a souvent cherché à leur donner." And that, though it is true, the vegetation of Tertiary Europe must have been remarkably similar, at one or other period, in general character to the existing vegetation of India, Australia, and Mexico, yet this conformity would, in his opinion, indicate rather that external conditions obtained at these respective Tertiary periods analogous to those of the regions specified, than that there must necessarily have existed ancient communication between these areas.* M. de Saporta is of opinion that like external conditions (convenances extérieures physiques ou climatériques) determine like structural modifications, and in this way he explains these remarkable and familiar analogies. It would not be easy to show why like external conditions should *not* determine like modifications, though the given conditions must be regarded, at the same time, as the agents of natural selection—being, indeed, both the determining cause and selecting agent of variation—but we think it can scarcely be said that experience has, as yet, materially confirmed the importance of external agents as the primary determining causes of variation. Their influence as selecting agents there can be no question of, though the consideration of their rôle as such is greatly complicated by important disturbing elements. These questions are too profound to enter upon here. The view which M. de Saporta holds upon them must, we think, undergo some modification, on a careful consideration of the recent writings of Messrs. Darwin and Hooker, which no one occupied in such speculative inquiries ought to ignore, and which may lead him further, to regard from a different point of view the old hypothesis which he favours, that species and types have, like the individual, their irrevocable term. He writes, "Mais, en dehors de ces causes destructives "(submergence, lowering of temperature, &c.) soit rapides, soit "lentes, il en existe une autre inhérente à la nature même des choses "créées, incessamment active, quoique d'une manière latente et par "des procédés inconnus: c'est celle qui se rattache au mode de dé-"veloppement des types organiques. En effet, les types végétaux "semblent doués d'une *vie qui leur est propre*."

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* M. de Saporta excepts, however, North America, which he says "toute porte à croire avoir été réunie à l'Europe pendant une longue série de siècles."

A study of Tertiary vegetation, in respect to the succession and mutual relations of the various types, leads M. de Saporta to recognise as a "loi très-importante dans l'étude des végétaux fossiles," that each group "se comporte à *travers le temps* comme il se comporte "à *travers l'espace*." He goes on to affirm "qu'il suffit de préciser "le caractère, les allures et la physionomie d'un groupe, la nature "des combinaisons auxquelles il donne lieu, pour connaître en meme "temps quel a dû être son rôle dans le passé." In support of this notion, he adduces, among genera at present numerous in species—*Pinus*, *Quercus*, *Ficus*, and *Cinnamomum*,—as formerly exhibiting like "fécondité," and a group now rich in form—Proteaceae—as having been anciently in like manner varied: genera which are restricted now, as Elm, Alder, and Hornbeam, formerly presented "inévitables répétitions des mêmes formes." We have no question at all that Tertiary data abundantly suffice to substantiate the facts M. de Saporta here states. We see in them, however, but further confirmation of the soundness of the observations of Mr. Darwin in the chapter on 'The Geological Succession of Organic Beings,' in his 'Origin of Species.' Indeed the theory of this distinguished Naturalist finds in M. de Saporta's "loi très-importante" but the feeble expression of a subsidiary corollary. Referring to the physiognomy of Tertiary vegetation, De Saporta states that, in the lower stages, broad and strongly veined leaves of large size prevail. Associated with these, at first in small, but in constantly increasing proportion towards the upper eocene, are narrow, long, coriaceous, spinose, or entire leaves (referred to Proteaceæ). To these the broad leaves at length in great measure give place, and become rare and exceptional. At a still later period the leaf-remains of the Tertiary beds indicate a vegetation more nearly similar to that of present Europe; the narrow, coriaceous leaves and small fruits, characteristic of the middle period in their turn disappearing. What M. de Saporta here says as to the general prevalence of different forms of leaf at different periods is doubtless true, but we cannot admit the value of such evidence as proof of his statement, that "les groupes les plus "éloignés se rapprochent alors en apparence par la propension qu'ils "ont à prendre des feuilles configurées d'une manière analogue." Nor do we find that "les formes végétales soumises dans leur en-"semble à une influence d'un ordre particulier peuvent revêtir une "physionomie commune,"—unless, perhaps, we except the spinose and woody character of desert vegetation, and one or two similar cases very imperfectly understood.

We must pass by the C. de Saporta's review of the geological features and relations of the Tertiary beds of Provence, and briefly notice the third and fourth chapters, devoted to descriptions of the vegetable remains of the lower lignites of the celebrated '*gypse d'Aix*.'

The remains referred to at some length by the author, in his important 'Examen des flores tertiares de Provence,'* published in Prof. Heer's 'Essai sur le climat, &c., du pays tertiare,' (p. 133), as of peculiar interest, from their occurrence at the bottom of the Provençal tertiary system, are here described in detail and figured.

They clearly belong to some Monocotyledon, although their affinities are excessively obscure, and can only be guessed at. An order—*Rhizocauleae*—is based upon these remains, which indicate leafy marsh plants with plane, finely striate leaves, destitute of a midrib. We see no reason why *Rhizocaulon* may not be, in every respect, as good a "genus" as are very many other fossil genera of even tertiary date, and we do not quarrel with Count de Saporta because he has thought fit to base a "natural order" upon these fragments of stem, surrounded by sheathing leaf-bases and adventitious rootlets. Our quarrel would be rather with the whole system of nomenclature of vegetable fossil remains, which is based apparently upon principles which unimaginative workers in the more sober field of recent systematic Botany can have but faint conception of, fast and loose enough though, in practice, these systematists may themselves too often be. However, we freely acknowledge the peculiar difficulty attending the nomenclature of these vegetable remains, and confess we have no better suggestion than an extension of the plan already adopted, viz., to leave in Carpolithes, Antholithes, Phyllites, &c., classed under each denomination as nearly in their natural affinity as may be, all the remains of fruit, flower, leaf, &c., respectively, until sufficient material be collected to base a reasonable generic diagnosis or identification upon. We would make of these a comprehensive dead-house, in fact, where the more miserable remnants might await their being matched.

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* See also 'Examen Analytique,' p. 17.

M. de Saporta's observations upon the determination of fossil plants, *apropos* of the Dicotyledonous remains of the "gypse," are of interest, setting forth the method pursued by paleontologists in a favourable light. Referring to the determination of isolated leaves, he writes—

> "On peut donc se demander quelles sont les règles qui dirigent cette étude encore nouvelle, et même si ces règles existent.
>
> "Sans nier ce que l'instinct plus ou moins heureux de l'observateur a pu mêler d'erroné à ce genre d'étude, surtout lorsque les empreintes ne sont pas visibles dans leur moindres détails, il serait injuste pourtant de le rejeter tout à fait; il vaut mieux se borner à proscrire l'emploi superficiel ou exagéré d'une méthode naturelle en soi; il vaut mieux surtout n'accepter que les déterminations sérieuses, en regardant les autres comme de simples vues provisoires. Quant à la manière de procéder pour s'égarer le moins possible, il nous semble que la meilleure est d'appliquer à l'étude des feuilles les principes qui président à la classification elle-même, c'est-à-dire de combiner plusieurs caractères, afin que leur réunion soit une sorte de garantie pour l'opinion que l'on adopte.
>
> "Pour cela, il faut considérer que les feuilles appartenant aux Dicotylédones forment un tout composé de parties solidaires que l'on peut isoler par le pensée: le *pétiole*, la *forme générale*, la *disposition des nervures principales*, enfin le *reseau veineux*, fournissent chacun de leur côté une série de caractères, dont il est aisé de se rendre compte. En suivant ce principe, on ne saurait admettre comme légitime toute détermination, où plusieurs de ces ordres de caractères ne se trouvent pas combinés pour le rendre vraisemblable." And, further, ". . . . à côté d'attributions fondées sur de simples feuilles qui nous paraissent probables ou même à peu près certaines, nous en proposons d'autres qui le sont beaucoup moins ou deviennent tout à fait incertaines Cependant nous avons fait de la nervation de nos espèces un examen tout spécial, et nous reproduisons dans plusieurs cas, à côté de l'empreinte fossile, la feuille vivante et sa nervation, pour permettre d'apprécier le degré de vraisemblance de notre opinion."

We hope, some early day, to return to certain remarkable analogical characters presented by the fruits and leaves of recent plants, remote in their affinity, with a view to the extreme caution such cases ought to inculcate, in founding genera and orders upon fragmentary remains.

Speaking of the numerous Tertiary impressions referred to Proteaceæ, M. de Saporta points out the remarkable absence, or extreme rarity, of fruits resembling those characteristic of existing Proteaceae. This is especially singular, from the woody or coriaceous character of the fruits of the group. From the great abundance, however, of the leaf-impressions, and their marked form and nervation, similar to that of the Grevilleas, Banksias, Dryandras, &c., of the present day, we are not bold enough to call in question the opinion generally conceded by fossil botanists and those who have discussed their results, that Proteaceae were a dominant group in Central and Southern Europe during the later eocene and miocene periods. M. de Saporta says, "qu'il n'est pas certain que les Protéacées tertiares aient été toujours pourvues des mêmes sortes de fruits ou de semences que celles de notre époque." This question resolves itself into—(1) Is it more likely that Proteaceae of the early Tertiary had different fruits from existing Proteaceae, than (2) that some other order of that period had leaves like Proteaceae of the present day. The uncertainty here referred to is an example of the cloud enveloping almost the entire study of fossil plant remains.

No fewer than six species of Pine are described from the "*gypses*,"—four with binate, two with ternate or binate leaves,—and five species of *Podocarpus*, a genus impossible to recognize from leaves alone. Surely sufficient allowance has not been made for the probable variability of a smaller number of species. *Podocarpus proxima* need not be distinct from *P. gypsorum;* indeed both, with *P. linearis* also, might belong to *P. Lindleyana.*

The determinations of Gamopetalae and Leguminosae are extremely unsatisfactory, as indeed are those of Professors Heer and Unger in the same groups. A Table is appended to the descriptive portion of M. de Saporta's Memoir, exhibiting the localities out of France where each species not confined to Provence is found; also the living analogue of most of the species and the country where such are found.

The discussion entered upon in M. de Saporta's brochure upon the rôle of deciduous trees in the older Tertiary, we cannot at present follow. In reference to it, his conclusions are, "that it is extremely probable that the deciduous plants of the Aix Flora occupied but a very secondary position, and if their impressions be very rare in the strata deposited at this epoch (prior to the miocene), this may be due to their habitat having been at some little distance from the ancient shores, to their isolated occurrence and medium size." Finally, he says, "we may state that the periodical fall of the leaf in these species, far from involving the existence of a cold season, is a phenomenon quite reconcilable with the high temperature to which was due the profusion of tropical forms in the Flora of the '*gypse d'Aix.*'"

XXXVI.—UEBER DIE GEFÄSSBÜNDEL DER PFLANZEN. Von Dr. R. Caspary.

BOTANISTS will be apt to be a little startled to learn from the distinguished and active Professor of Botany in the Königsberg University that the greater number of Monocotyledons, as well as several Dicotyledons, are wholly or partially (*i. e.* in at least some of their organs) destitute of 'vessels.' And their surprise will be none the less that amongst these evascular plants are included genera which have been usually regarded as possessing vessels of unusual length and diameter, as, for example, the *Banana* (stem), *Nelumbium*, and the Water Lilies.

The above paper, of 34 pages, Dr. Caspary tells us is preliminary. A more complete essay upon the subject of vascular bundles he hopes to publish at some future time. It suffices, however, to enable us to form a tolerably fair estimate of the bearing of the principal points advanced, which, after all, seem to us considerably less important than at first sight might appear. The question hinges upon the definition of the vessel. If we strictly agree with Von Mohl, that it must consist of a row of superimposed cells, which have become combined into a tube through the absorption of their cross walls, we must necessarily admit with Caspary, that, provided his observations are correct, many of the higher plants are evascular.

On the other hand, it must be borne in mind that some Botanists have not accepted this definition. The late Professor Henfrey, in the 'Micrographic Dictionary' (1856), says, "The term vessel is now "generally contrasted with *duct*, to indicate a single, long tubular "cell, with spiral deposits, in contradistinction to a canal formed of "a row of short cells of similar character applied end to end and "confluent." Spiral vessels, he says further, though usually simple at first, "ordinarily unite together by a kind of fusion; the conical "extremities overlap to a certain extent, and thus the articulation "is more or less oblique." These confluent vessels "pass insensibly "into the ducts, which are similar confluent rows of cells with flat "ends applied together." Of course the presence of either ducts or vessels, thus distinguished, determined the vascular bundle in Professor Henfrey's practice, as indeed in the practice of Botanists generally. But no one could be more fully aware of the very gradual transition between cell and vessel than Von Mohl himself. He expressly says, "No sharply defined line can be drawn between vessels and cells." And the following passage, which we quote from his well-known "Principles of the Anatomy, &c., of the Vegetable Cell" (Henfrey's Translation, p. 2), must indicate pretty clearly the comparatively small importance in either a structural or physiological point of view, this eminent phytotomist must attach to Dr. Caspary's observations. It may be noted that Von Mohl here speaks of vascular plants as the equivalents, not of one, but of both the sections (*plantæ fasciculares*) of Caspary, in contradistinction to cellular plants as generally understood.

"The circumstances, that a plant is composed of cells alone, or "also possesses vessels, have not that importance either in a systematic or a physiological point of view which De Candolle attributed "to them when he used them for the primary division of the vegetable kingdom, into cellular and vascular plants, for these conditions do not run parallel with the total organization of plants, "since there exist both Cryptogamic and Phanerogamic plants with "and without vessels."

Dr. Caspary does not disguise the extreme difficulty of determining in some cases whether we have to deal with single cells or with a row of confluent cells. In the first place, the cross partitions which separate the cells in the compound vessel are very frequently but partially absorbed. It is usual in many plants to find traces of these transverse septa in the form of a network or transverse bars, the primary membrane only which occupied the interstices having been absorbed. But even this absorption of the primary membrane may often take place at a late stage in the development of the vessel, if indeed it do not often persist until the vessel ceases to take any active part in the economy of the plant. The age of the tissue, therefore, is a second consideration not to be lost sight of. Since then the technical distinction between cells and vessels rests upon the absorption more or less of the intervening partitions, which absorption may be of the smallest possible amount, we believe that in very many cases it will ever remain a matter of doubt whether a plant be vascular or evascular from Dr. Caspary's point of view. We therefore think it undesirable to adopt the terminology proposed by Dr. Caspary for the general purposes of plant anatomy, though in some special investigations it may be well to employ it. At the same time we would not be understood as wishing to imply that the careful investigation into the composition of the various tissues of plants is unworthy of the endeavour of botanists competent to undertake such inquiries. Far from it. We regard Dr. Caspary's essay as of no small interest, and as a contribution to Vegetable Anatomy likely to help us to future important generalisations. The principal features we shall briefly note.

The author's attention appears to have been first directed to the subject by his researches on the Anatomy of the Nymphæaceæ, in which he found the so-called vessels to be made up of series of distinct cells. The absence of vessels in the wood of Coniferæ (exclusive of Gnetaceæ) and Cycadeæ has long been known. Recently Mettenius has pointed out that Ferns, Lycopods, Equiseta, &c. do not possess compound vessels, and this observation Caspary confirms and extends to Isoeteæ. We observe, by the way, that Schacht, in his 'Lehrbuch,' refers to the composition of the vessels of *Isoetes*, and states the same fact as Caspary.* Around this nucleus many additional observations have been accumulated, especially by our author, enabling him to announce some general propositions, which, however, require, as he most fully admits, to be securely established upon yet more extended comparative investigation. We have stated that he finds the greater number of Monocotyledons to be destitute of compound vessels (ducts). Of nineteen Natural Orders, of which he has examined one or more representatives, he finds but five (Palmeæ, Commelyneæ, Junceæ, Gramineæ, and Cyperaceæ) have compound vessels in all their organs. Six other Orders are destitute of these in all their organs (Aspidistreæ, Hydrocharideæ, Orchidaceæ (partim), Aroideæ (partim), Lemnaceæ, and Naiadeæ). The larger proportion have them in their roots. Amongst Dicotyledons destitute of vessels, as Caspary understands them, are *Aldrovanda*, Nymphæaceæ, *Ceratophyllum*, and *Monotropa*. *Houttuynia* wants them in its leaves. The relations of the different modifications of vascular tissue in the several organs are described in a few aquatic genera of Dicotyledons and in *Viscum*. Dr. Caspary classifies the tissues thus: *Plantæ vasculares* of authors, he styles *Plantæ fasciculares*. These are divided into *Pl. fasciculares vasculares* (with compound vessels) and *Pl. fascic. cellulares* (with simple vessels). The principal modifications of both are distinguished by their secondary deposits, whether annular, spiral, reticulated, scalariform, or dotted; these adjectives being respectively prefixed to vessel or conducting-cell (*cellula conductrix*, *leitzelle*) according as they are compound or simple.

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* Vol. i. 227. Speaking of the vessels of the abbreviated axis of *Isoëtes*, he says:—"Die Querwände der mit einem Spiralbande versehenen Zellen scheinen hier nicht durchbrochen zu sein."

We have referred to the often extreme difficulty of determining whether the pores of the cross partition walls of vessels be open or closed. It is recommended to examine the cross wall under a thin covering-glass after it has dried up, when the presence or absence of a membrane over the pores or slits may be ascertained by several delicate tests, chiefly optical, and, as we believe, very liable to deceive, as the colour of the light passing through the pores, or reflected from the membrane, the presence of microscopic particles on their surface, &c.

XXXVII.—OM GALAPAGOS-ÖARNES VEGETATION. 1857.—ENUMERATIO PLANTARUM IN INSULIS GALAPAGENSIBUS HUCUSQUE OBSERVATARUM. 1861.—UEBER DIE VEGETATION DER GALAPAGOSINSELN. LINNAEA, 1862. By N. J. Andersson.

FROM the very peculiar interest attaching to the Galapagos Archipelago in a Natural History point of view, it is with pleasure we find Dr. Andersson at length giving us an excellent *resumé*, in German, of the remarkable botanical features of the group, embodying some important results, acquired by himself on the occasion of the visit paid to the Islands by the Swedish exploring frigate "Eugenie," to which he was attached as botanist. It is true some twelve years have elapsed since Dr. Andersson's return, but nothing has been done in the meantime to disturb his summary. Surely another twelve years cannot pass without some worthy enterprise in this quarter! A great deal remains to be done. Were an opportunity to offer of getting across from Guayaquil, and then again from island to island, through favour of some East Pacific cruiser, or otherwise, we should not fail to find plenty of zealous naturalists ready for the adventure. The issue could scarcely be other than highly important to science and creditable to our Government, if, through its patronage, the visit were accomplished.

We say much remains to be done. The island Indefatigable, the second largest of the group, and upwards of twenty miles across, was visited by Dr. Andersson. He was the first botanist who ever set foot on it, and his stay was but for a few hours of one day. Nevertheless, several species of great interest were met with, including nine, which, so far as we know, are peculiar to this island, and new to science. Indefatigable, however, has a comparatively very poor Flora. From the rest of the group touched at by the Swedish expedition, in the course of an eight days' stay in the Archipelago—Chatham, Charles, Albemarle, and James—some 70 new species were collected by Dr. Andersson, and a considerable amount of material accumulated, serving as the basis of a more thorough investigation than has been hitherto feasible into the peculiar relations of the Galapagos Flora, both in respect to the dispersion through the group of the very numerous endemic species, and those common to other areas; no fewer than 118 species being added to the Galapageian Flora.

Dr. Hooker's well-known essay on the Flora of these Islands appeared nearly sixteen years ago.* It was based upon all the collections made previous to that date, the most important of which were those of Mr. Darwin, who visited four of the Islands in the Beagle expedition (1835), of Edmonstone, in the Herald (1845), and of Macrae, Cuming, and one or two others who gathered a few plants in one or other of the Islands. These are, of course, all worked up in Dr. Hooker's paper. His enumeration included 225 species of flowering plants. Dr. Andersson's additions make a total of 332 Phanerogamia, of which no fewer than 174 appear to be peculiar to the Galapagos group. With this new material, Dr. Andersson has been enabled to extend and modify the comparisons instituted and suggested by Dr. Hooker. The result of these comparisons we briefly notice.

Dr. Hooker directed attention† to the unusually small proportion borne by Monocotyledons to Dicotyledons in the Galapagos Flora, the material at his disposal indicating the former as hardly equal to 1/9th of the latter. Dr. Andersson reduces the proportion to 1/6th, estimating the Monocotyledons at 47, or 1/8th of the entire vegetation. Of these 47,22 species are endemic. It must be borne in mind, however, that Monocotyledons are almost invariably more imperfectly represented than Dicotyledons in the early collections received from countries but little explored. This arises partly from the circumstance that many Monocotyledons wither up and wholly disappear in the dry season, and partly because many of them have very inconspicuous flowers. Grasses and sedges, indeed, are often quite neglected by non-botanical collectors. Of the total Phanerogamia (332) 174 species are, as stated above, endemic. This extraordinarily large proportion of peculiar species presents itself under a very remarkable aspect when we inquire into the relations of the different Islands to each other in respect to the endemic plants. Each Island, as Dr. Hooker observes, stands, in this regard, in nearly the same relation to the rest of the group that the whole Archipelago bears to the American continent and the Polynesian Islands. For example, of the above 174 peculiar Galapageian species, only five are common to the five Islands, the botany of which has been hitherto partially explored. Very few indeed are common to any four, three, or two of the Islands, while Chatham possesses 26, Charles 40, Indefatigable 9, Albemarle 22, and James 26 (38 in Dr. Hooker's Essay), peculiar to these respective Islands. The species common to five Islands or fewer, the Islands being specified, are tabulated.

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* Linn. Trans. xx. 235.

† Linn. Trans. xx. 239.

The relative proportions of the prevailing Natural Orders indicated by Dr. Hooker are necessarily altered by the recent additions. The largest 10 stand thus :—

Compositæ number 40 species, constituting 1/8th of the Phanerogamia; 29 species (and 22 genera) are endemic; of the remaining 11, 8 are North American.

Leguminosæ, 30 species; 1/10th of Phanerogamia; 7 endemic. No new genera.

Gramineæ, 32 species; over 1/10th Phanerogamia; 15 are endemic; 14 of the remainder common to America and the Antilles.

Euphorbiaceæ, 29 species. 1/12th Phanerogamia—a relatively larger proportion than in any other area; 22 are peculiar; of these Charles Island possesses 12, Chatham 12, Albemarle 9, James 6, Indefatigable 1. 20 species are confined each to a single Island.

Amaranthaceæ, 18 species; 1/18th Phanerogamia, 13—15 are peculiar.

Rubiaceæ, 16 species.

Asperifolieæ (Tournefortieæ, Heliotropeæ, &c.), 13 species.

Solanaceæ, 12 species.

Cyperaceæ, 12 species.

Convolvulaceæ, 12 species.

The Galapageian species Dr. Hooker referred to two main types: (1) the West Indian (including Panama), which he stated to include nearly all the plants common to other countries; and (2) the Mexican and temperate American, under which "the great majority" of the peculiar species rank.

Dr. Andersson's collations extend and confirm the correctness of this reference. Of the Continental species growing in the Galapagos, 1/3rd, or a total of 63, are common to the Old as well as to the New

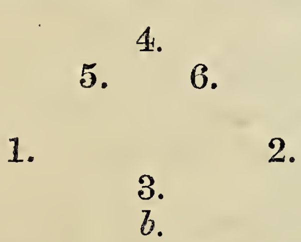
World. Of these, thus extending westward as well as eastward from the Galapagos, some reach the Cape Verd Islands, West Africa, and the Cape of Good Hope, others fall off in Asia or its islands. But deducting 17 cultivated plants, or weeds of culture, from the above, the remainder, Dr. Andersson shows, are found to be species common to both hemispheres. This does not, however, invalidate the preponderant evidence in favour of the Central American and West Indian type. With regard to the relations of the species now endemic, Dr. Andersson has some interesting observations in connection with the inquiry as to their probable origin. From a collation of representative and analogous forms, he arrives at the conclusion, confirming that arrived at by Mr. Darwin from zoological evidence, that it may be reasonably assumed that the Galapagos have derived their species from the American mainland, and that through the course of innumerable centuries a constant divergence from parent types has been in progress, resulting in the peculiar modifications which characterize the Flora of the present period.

XXXVIII.—MÉMOIRE SUR LA FAMILLE DES JUGLANDÉES. Par M. Casimir De Candolle. Ann. Sc. Nat. 4e. Sér. xviii.

THREE months ago we had occasion to notice the essay of M. Alphonse De Candolle *apropos* of his revision of the Cupuliferæ for the Prodromus. The memoir now before us, by his son, M. Casimir, contains a *resumé* of various organographic and miscellaneous observations, accumulated during a like revision of the Juglandeæ for the same work. It contains some valuable matter, scattered through 40 pages, concerning this small Natural Order, which is one of peculiar interest, from the narrow range of its species in respect to structure—from its serving, like another very restricted group, the Hamamelideæ, as a connecting link between Orders of simple and of complex floral and carpological character—from the wide geographical distribution of the species, and from the important part which there can be no doubt they filled in the Flora of Tertiary Europe.

Of the affinities of the group, very little is said. There is not much, indeed, to say. Dr. Lindley's view, that they are related to the oaks and chesnuts, M. De Candolle rejects, on the ground of the simple leaves, divided ovary, and usually pendulous or laterally attached ovules of these genera. This suffices to preclude their being actually classed among Corylaceæ, which, indeed, Dr. Lindley does not attempt, although M. De Candolle almost leaves it to be inferred that he does so. His words are, "Cependant M. Lindley (Veget. "Kingd.) les réunit à l'alliance des Corylacées, qui comprend les "genrés *Corylus*, L., *Fagus*, L., *Castanea*, Gaert., *Quercus*, L." Dr. Lindley includes Juglandeæ with Corylaceæ in his *Quernales*—the "Quernal Alliance," and says of their representative, "If the walnut "had a many-celled fruit and a cupule, there would be no very good "reason for separating it from Mastworts, except its resinous "juices." He nowhere goes the length of saying the walnut has either a many-celled fruit or an acorn-cup. It is by no means clear to us that Juglandeæ could have been better placed than in the 'Vegetable Kingdom.' The divided stigma of the Order appears to us as important an item in estimating the relationship between walnuts and oaks as is that of the crumpled cotyledons of some oaks, advanced by Dr. Lindley. This indicates the essentially compound character of the ovary in the walnuts, while Corylaceæ, on the other hand, with this compound character yet a stage more fully expressed in the development of dissepiments in the ovary, are nevertheless almost invariably one-celled in fruit. It does not appear whether the accidental occurrence of two or more-celled Juglandeæ has ever been observed. The relationship of the group to Anacardiaceæ adopted from Jussieu by the elder De Candolle, the author of this Memoir, as a dutiful grandson, appears more willing to favour. His suggestion of an analogy with Myricaceæ, a small and neglected order, is interesting.

The Memoir is divided thus: Chapter I. Généralités. Distribution Géographique.—II. Organes de la Végétation.—III. Organes de la Fructification.—IV. Espèces et Variétés Nouvelles.—V. Division de la Famille et ses Affinities.—VI. Juglandées Fossiles. The most important observations appear to be those upon the organogeny of the flowers, and the common types to which the male and female may be respectively referred. In the walnut, the male flowers are arranged in lateral catkins, each flower being subtended by a small bracteole, along which bracteole the base of the 6-lobed perianth is adnate. This perianth contains a variable number of stamens, in two or more rows, the outer set alternating with its divisions. The two outer perianth-lobes are antero-lateral, denoted by the figures 1 and 2 in the adjoining diagram, *b* representing the subtending bracteole. The next following lobes are anterior, 3; and posterior, 4; the innermost two are postero-lateral, 5 and 6. In *Carya*, M. De Candolle describes the perianth of the staminate flower as 3-lobed, one of the lobes being anterior and exterior. This is the bractlet. The perianth proper, we should say, is reduced to 2 lobes, answering to the lobes 1 and 2 in the walnut. These, however, are adnate with *b*, and form a single envelope. Thus, in *Carya* we have the flower of *Juglans* with the perianth lobes, 3, 4, 5, and 6, undeveloped.



With regard to the female flowers of these genera, in the walnut the six lobes of the perianth and the bracteole are united together with the ovary. The bract and perianth-lobes, 1 and 2, constitute the outer, the four remaining perianth-lobes the inner perianth. In the pistillate flower of *Carya* the bract and three of the lobes unite together to constitute a single perianth. M. De Candolle does not explain how it is that the third lobe, which is developed in *Carya*, answers to lobe 4 and not to 3, being posterior and opposed to the bract. He states, however, that lobe 4 exists often in the male flower, especially in *C. olivaeformis*. In brief, the perianth of the male flower of *Juglans* consists of lobes 1 to 6, adnate to the subtending bracteole; that of *Carya* consists of lobes 1 and 2 only, similarly adnate. In the female flower of *Juglans* all the perianth-lobes of the male are represented. In that of *Carya*, lobes 1, 2, and 4, with the adnate bracteole alone form the 4-lobed perianth.

In the genus *Platycarya* (*Fortunæa*, Lindley) we have a yet more simple floral structure. It is thus interpreted: the male flower consists of stamens inserted upon a disk in the axil of the bract, and is destitute of a perianth. In the female flower there are two lateral appendages adnate with the ovary, which is inserted in the axil of a free bract. These appendages are regarded as representing two of the lateral stamens of the male, the perianth being wholly abortive.

An instructive account is given of the morphological relations of the septa, which are intruded into the originally 1-celled ovary of Juglandeæ. With respect to the characters which distinguish *Carya* from *Juglans*, besides those already referred to in the flower, M. De Candolle points out that the fruits of *Carya* differ in the two valves being opposed to the stigmas, not alternate with them as in *Juglans*, in the sutures of these valves being but slightly marked, and the surface usually smooth or finely striate. We shall be curious to learn how far the relation of the valves to the stigma is a constant distinction. At present we can scarcely concur in the propriety of generically separating *Carya* from *Juglans*, especially that, as M. De Candolle says, the number of lobes of the perianth, employed as an important generic mark, is almost always reduced towards the extremities of the male catkins in *Juglans*—the terminal flowers having but a 4 or 3-lobed perianth, as in *Carya*. It is worth while, in connection with this reduction, to refer to the observations and reasoning of M. Alph. De Candolle upon characters variable in the same specimen, and their application for systematic purposes, in the Memoir upon the Cupuliferae before referred to.

About 40 fossil tertiary species of Juglandeæ have been described. Although a very large proportion of these are probably either not Juglandeæ at all, or not specifically distinct, yet we may safely assign an important rôle to the group at this early period. At the present time M. De Candolle reckons but 34 species. He has had the opportunity of examining but three fossil fruits, and these he inclines to refer to *Juglans* rather than to *Carya*; an item of evidence, by the way, favouring an Asiatic rather than an 'Atlantis' migration, as explanatory of the community of type in the Tertiary vegetation of Europe and that now existing in East America.

Six illustrative plates accompany the Memoir.

XXXIX.—PRODROMUS FLORÆ NOVO-GRANATENSIS, OU ÉNUMÉRATION DES PLANTES DE LA NOUVELLE-GRENADE AVEC DESCRIPTION DES ESPÈCES NOUVELLES. Par MM. J. Triana et J. E. Planchon. Annales des Sciences Naturelles, ser. 4, vol. xvii. Botanique (to be continued and reissued as a separate publication).

MÉMOIRE SUR LA FAMILLE DES GUTTIFÈRES. Par J. E. Planchon, D.M. et José Triana, D.M. Annales des Sciences Naturelles, ser. 4, vols. xiii to xvi., (reissued in a separate volume). Paris, 1862.

THESE two papers are good examples of the two classes most to be recommended to partial workers in systematic botany, as useful contributions to science, although in different degrees—a critical enumeration of all the plants of a country, and a monograph of all the species of a group—the one more practically useful to the investigator of the vegetable productions of the particular country referred to, the other always a much greater step in the advancement of science. Although one of them is as yet a commencement only, we here take them together as being by the same authors, the one having as it were grown out of the other. Both papers are distinguished by accuracy of observation and soundness of views, and illustrate well the comparative merits of each class of works.

Dr. José Triana, an active and intelligent young botanist, a native, as we believe, or at any rate a citizen of New Grenada, was employed in the chorographic expedition organized under the administration of General J. H. Lopez, and after six years of travel through the various provinces of that republic, he came over to Paris in 1857, for the purpose of determining the specimens he had collected, with a view to compiling, for the benefit of his countrymen, a popular work on the vegetable productions of their territory. The first inspection, however, of the herbaria of Paris and London showed him how little was as yet really known of the vast botanical treasures of that luxuriant district of tropical America, and that a compilation was impossible for want of any scientific investigation on which it could be founded. He therefore changed his plan, and having secured the collaboration of Dr. Planchon, whose guidance as to the scientific portion of the work was essential, and having, after much negotiation, obtained the indispensable sanction and promise of support from the Government of his country, he set earnestly to work at a general Flora of New Grenada. For this he had excellent materials. Besides his own collections and those remitted to him by M. Linden, he had all those of the Herbarium of the Jardin des Plantes, where he worked, and he was enabled to borrow much from the herbaria of Delessert, De Candolle, Boissier, and Sagot. For the necessary consultation of books he was not so well off. The library of the botanical department of the Jardin des Plantes is confined to a few only of the systematic works in most common use, and although Delessert's Botanical Library, one of the richest known, is liberally open to all working botanists, the crossing half Paris every time a reference was to be verified was more than could be expected. Another drawback was the residence of his collaborator at Montpellier, at a distance of 500 miles from Paris, and away from any rich general herbarium. This entailed long correspondence and repeated delays, and when at length the first volume was ready for press, revolutions and civil wars stopped all supplies from the Government of New Grenada, and after years of alternate hopes and fears the completion of the great work originally contemplated was indefinitely postponed. The present Government, has, however, so far come forward as to enable arrangements to be made for the publication of the first volume at least in an abridged form, in the Annales des Sciences Naturelles, in detached portions, to be afterwards reissued as a separate work. This mode of publication, which the authors also adopted for the monograph of Guttiferæ, has the advantage of saving from pecuniary loss scientific labourers who can ill afford it; the chief inconvenience, independent of delay, is the impossibility of ascertaining the date of publication of new species in case of disputes as to priority, the Annales being habitually antedated, while the collected volumes are in a great measure post dated.

In substance this Prodromus Floræ Novo-Granatensis is not an abridged synopsis for the use of residents or travellers in New Grenada, but a critical enumeration for the use of the general botanist who has a library at his command, for diagnostic characters are not given. The names of the published species are accompanied by such references, ascertained synonyms, or critical observations, as the earnest labours of Triana, and the extensive knowledge and sound judgment of Planchon have enabled them to supply; the observations always given in the French language. The new and imperfectly known species are described in Latin, the descriptions being given in the nominative case where the species had been previously published, in the ablative case when new, a distinction of which we do not see the benefit. The ablative absolute was the form given by Linnæus to his diagnoses in which he expressed within the prescribed limit of twelve words the most striking or best contrasted characters of each species. These might be sufficient so long as the species of each genus or section were few and comprehensive. But as the number of species increased, and their variability became better known, diagnoses professing to include all absolute characters (*i. e.* all those without which a plant would not be conspecific) came to be more extended, the twelve words growing into more than as many lines, numerous alterations were introduced in order to admit all known varieties, until, in many recent works the description of all modifications in number, form, or structure, conventionally taken as absolute or essential characters has been introduced into the ablative diagnoses, and the nominative description has been reserved for little more than dimensions, colour, etc. supposed to be accessory only. There are some cases, however, where, within certain limits, dimensions and colour have proved more constant than form or number; accordingly even those are now admitted into the ablative diagnoses, which, in Triana and Planchon's Flora for instance, only differ in general from descriptions in their inconvenient phraseology. It would be a great improvement in our modern systematic works, whether Floras or Monographs, if the Linnean restrictions on diagnoses were again enforced, including in them only the most striking, essential, or contrasted characters, under the distinct understanding that they are to serve as a guide only to the reader, who would then rely upon the detailed description in a more manageable nominative form, in broken sentences, for the absolute identification of his species.

At the conclusion of each natural Order a few lines are very usefully devoted to a sketch of the geographical relations of its New-Grenadine representatives, and the synonymy and critical observations are, as might be expected from so sound a botanist as Dr. Planchon, generally to be depended on so far as they go. But in this respect, as well as in specific affinities, completeness as to what is already known, and even in some cases accuracy, can only be attained by treating each species or group in succession monographically. It is for this reason that, with equal merits of authorship, the observations of the monographist always inspire greater confidence, and are therefore much more important than the passing criticisms of the enumerator of the plants of a collection, or of a district. The need of such a comprehensive research became particularly apparent to our authors when they came to Guttiferæ, of which they had much that was new to deal with. This Order is much more abundant within the tropics, than the comparatively scanty specimens we possess would lead us to suppose. The rigid succulent or gummy leaves, flowers, and fruit, are not tempting to ordinary collectors, who seek for showy plants, easily preserved. The specimens are, moreover, very apt to fall to pieces when dry, the flowers are often few and mostly diœcious, and thus complete and well-matched specimens of some of the commonest kinds are rare in herbaria. Guttiferæ had thus been generally neglected, or, with few exceptions, ill-defined and badly grouped. The new forms supplied by the New Grenada collections could not be determined without a revision of the genera next to which they should be placed, and Dr. Planchon's sagacity soon discovered the necessity of remodelling the whole system of their classification. In attempting this he found so much that was new and interesting in the varieties of floral structure and symmetry in species otherwise too closely allied to be generically separated, that he and his collaborator were induced to proceed to a detailed examination of every species of which they could procure specimens, and thus it was that the excellent and elaborate monographic memoir grew out of the enumeration they were preparing. And no work illustrates better the impossibility of determining *a priori*, whether a character first observed in a newly-discovered species is or not a good generic distinction. Their first impulse in determining M. Triana's novelties was to propose a number of new monotypic genera. In their first general synopsis of the genera of the Order, they were induced to consolidate a few of these, as well as several similar ones, proposed by other botanists—and at length the careful examination of all the species made them hesitate about the distinctness of several more, which they had retained in their first general review. A still further consolidation has, in some instances, been proposed by Bentham and Hooker, in their Genera Plantarum, where they have in all essential particulars confirmed and adopted the views of Messrs. Planchon and Triana.

The striking peculiarity of Guttiferæ being the great diversity of structure in a very natural group, "variety in unity," as our authors express it, the difficulty of dividing it into tribes and genera was not, as in many other cases, to find characters, but to select them, and in this Messrs. Planchon and Triana have been eminently successful; they reject, as secondary, the placentation of the ovary and the nature of the fruit (as to consistence, dehiscence, &c.) and place still lower down the estivation of the floral envelopes and structure of the andrœcium, giving primary importance to the structure of the seed. It had long been known that the embryo of many Guttiferæ appeared in the form of a thick, hard, fleshy homogeneous mass, traversed, in some instances, by a linear distinct portion of a looser texture; on the other hand, two large fleshy, more or less distinct cotyledons had been observed in Calophylleæ; and in two different species of *Clusia*, two minute but distinct cotyledons at one end of the homogeneous mass had been pointed out by L. C. Richard and by Turpin, but overlooked by most subsequent authors. This gave rise to much discussion, whether the ordinary embryo of the Order must be considered as composed of two consolidated cotyledons, or of an albumen with a slender central embryo, or of an albuminous development of a central radicle, with minute or wholly aborted cotyledons. Dr. Planchon has shown that all these explanations are wrong if applied to all Guttiferæ, as there are, in fact, three distinct types of embryo. 1stly, An enormous apparently homogeneous radicle (rostellum, tigellus, or caulicle, of modern refined terminologists), with two small but distinct cotyledons at one end, and developing the root from the other end; 2ndly, An equally large radicle, traversed by a central pith, the cotyledons wholly aborted or so rudimentary as to be rather imagined than seen; and 3rdly, Two large fleshy cotyledons, with an exceedingly small radicle.* These are taken as the essential characters of the three principal tribes, Clusieæ, Garcinieæ, and Calophylleæ. A few species, with a peculiar habit and style, are distinguished from Garcinieæ as a fourth tribe, under the name of Moronobeæ, and the anomalous genus *Quiina* is added as a fifth tribe. It might be objected, that the embryonic character is practically useless, as it is very rare to find seeds in herbarium specimens, and some might think that it wants verification, not having been ascertained in one-half, perhaps not in one-fourth, of the species known. But it has been ascertained in so large a proportion of the genera that we are justified in inferring its constancy; and, for practical purposes, it is accompanied by a combination of secondary characters, derived from the flower, which will readily guide us to the proper tribe, independently of the general facies peculiar to each. Thus, Clusieæ have distinct broad radiating stigmas, either sessile, or borne on distinct styles, the number of ovules in each cell of the ovary being variable; Moronobeæ have a single branched style, and always several ovules to each cell; Garcinieæ a single peltate stigma, and only one ovule to each cell; and Calophylleæ an elongated single or branched style, and one, two, or four ovules to the whole ovary.

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* By some oversight, the detailed observations on the structure of the seed of the Calophylleæ are omitted in Messrs. Planchon and Triana's Memoir. In p. 220 we are referred to the organographic part, where, p. 327, three types of Guttiferous embryos are spoken of, but only two described.

In form, the memoir is divided into two parts, systematic and organographic. The first portion is very detailed, and, as far as the genera are concerned, the form adopted is excellent, that of a short synopsis of contracted characters, and detailed descriptions under each genus. As to species, the new and little-known ones are carefully and accurately described, although, in some instances, multiplied beyond what our own experience would justify, and we regret to see that confusion we have already remarked upon between ablative and nominative descriptions, with nothing to guide the reader in the shape of short diagnoses or tabular synopses of contrasted characters. Several species also, supposed to be sufficiently known, are accompanied by references only to published works, without either character or description. This practice, generally pursued in many of the most valuable and elaborate French monographs (*e. gr.* in A. de Jussieu's admirable Memoir on Malpighiaceæ) diminishes much their practical utility, inasmuch as it prevents the determining a plant without recourse to other works often too costly for the private library of a botanist, and the only advantage gained is the saving of a few pages of letter-press. The labour of adding a few characteristic lines to each of these species would be very little, the authors having necessarily verified the published descriptions of all the species. French botanists entertain, however, the idea that, by combining what might be (though falsely) taken for mere compilation with their original observations, they would diminish the scientific reputation of their work. This appears to us to be a great mistake. We cannot consider it any detraction from their personal glory to have combined practical usefulness with intrinsic merit.

The organological portion contains much that is deserving of study, especially as to the variability in some genera of characters, which, in other instances, are considered almost of ordinal importance. The diversity of floral symmetry is much dwelt upon. Opposite decussate foliar organs with whorled or variously imbricate floral organs are not unfrequent among Dicotyledons, but here we have the arrangement diversified by the decussation more or less invading the flowers, or by the irregular imbrication descending into the bracts, besides great diversity in the mode of imbrication or superposition of the floral parts. The number, position, and structure of the stamens present in the large and very natural genus *Clusia* discrepancies, which would, we believe, in scarcely any other instance be admitted as of anything less than generic value. The two opposite positions of the raphe, ventral or dorsal (with the ovule in both cases pendulous), which many modern botanists, especially those of the organogenic school, consider as absolute ordinal characters, are here exemplified in two monotypic genera, *Pilosperma* and *Havetia*, scarcely distinguished from each other in any other particular. The diversities in the fruit of Guttiferæ and the much-discussed question of the integuments of the seed are also entered upon by Messrs. Planchon and Triana, as well as the little that is known on its germination. But the latter portion of the Memoir appears to have been cut short, in order to enable the authors to resume the Prodromus of the New Grenada flora, which is also the reason alleged for deferring, for the present, the intended third part of the Memoir, treating of the geographical distribution, affinities, and economic application of Guttiferæ. It is to be hoped, however, that circumstances may ere long enable Dr. Planchon at least to publish the remainder of his observations on this most interesting Order, which cannot fail to be a valuable contribution to science.

XL.—BOTANY OF THE JOURNEY OF H.R.H. PRINCE WALDEMAR OF PRUSSIA (DIE BOTANISCHEN ERGEBNISSE, &c.). The Plants collected by Dr. Werner Hoffmeister, Physician to H.R.H. in Ceylon, the Himalaya, and on the borders of Tibet, and described by Dr. F. Klotzsch, and Dr. Aug. Garcke. With 100 lithographed plates. Berlin, 1862. 1 vol. 4to.

DR. HOFFMEISTER was attached as physician to the suite of Prince Waldemar of Prussia, who made a tour through British India in the year 1845. The party visited Ceylon, proceeded to Calcutta, and thence to Nipal, where, as usual, the narrow and exclusive policy of the authorities, debarred all access to the interior of the country, and restricted them to the neighbourhood of the Valley of Katmandu, the capital. From Nipal they proceeded to Naini Tal, in Kumaon, from which place their Himalayan travels may, in fact, be said to have begun. From Naini Tal they struck into the mountains in a N.W. direction, crossing in succession the lofty mountain ranges, which separate from each other different tributaries of the Ganges, gradually increasing their elevation as they came nearer to the snowy mountains. After a visit to Gangutri, near which place the main stream of the Ganges issues from beneath a glacier, they crossed a lofty pass from the Ganges basin into that of the Sutlej, entering the district of Kunawer by the Baspa valley. In Kunawer, they ascended the Sutlej valley as far as Shipke, on the borders of Chinese Tibet. Thence they returned to the Indian plain by Simla, just at the time when the invasion of British territory by the turbulent Sikh soldiery of the Punjab began the campaign of 1845-6. The Prince and his suite were present at the battle of Ferozeshah, on the 21st of Dec. 1845, in which action Dr. Hoffmeister was unfortunately killed by a grape shot whilst riding by the Prince's side.

During this journey, which had so sad and unlooked for a termination, Dr. Hoffmeister was a close observer of the natural features of the country traversed, and made an interesting botanical collection. Botany was of course only one of many subjects to which his attention was directed, and the travellers passed over the ground too hurriedly to permit of extensive collections being made. It will be seen from the sketch just given that the journey lay through countries already more than once explored by Botanists. Nipal was for a long time the head-quarters, first of Wallich himself, and then of his staff of collectors. It does not appear, however, that Dr. Hoffmeister collected to any considerable extent while there. The province of Kumaon was carefully examined by Blinkworth, and others of Wallich's collectors. Garhwal is that part of the Himalaya nearest to the Saharanpore Botanic Garden, and had been for a long succession of years visited by Royle and Falconer. Kunawer, on the north face of a snowy range which separates the Jumna and Ganges from the Sutlej, had not only been traversed by Royle's collectors, but had been most carefully explored by Jacquemont, whose observations and results were before the world.

The lamented death of Dr. Hoffmeister prevented any revision of his memoranda on the vegetation of the country; and also the arrangement of the collections. With the exception of the Ceylon plants (few in number), the specimens have no special localities attached. The published list, however, shows that the collections were made chiefly, if not entirely, in the western Himalaya, in a journey of about three months, during which a very great extent of difficult country was traversed at a rapid rate, which must have made the preservation of the specimens both difficult and laborious. It is, therefore, creditable to Dr. Hoffmeister, that he should have brought away with him so many interesting plants, in sufficiently good condition for accurate determination, as are contained in the list. The number of plants in the collection is estimated by Dr. Klotzsch at 456, of which figures are given of 102 in 98 plates.*

With every desire to avoid anything like censure on a botanist so distinguished and deservedly esteemed as the late Dr. Klotzsch, by whom the determinations of genera and species in this work were made, it is impossible to avoid remarking on the extreme laxity of ideas regarding the value and distinctness of genera and species, which has led to the establishment of so many bad genera and species. In justice to Herr Garcke, we must not omit to mention that he is quite conscious of this defect, and that he has rectified it as far as he felt able to do so. The number of new genera indicated is seven, of which Garcke has reduced four, namely, *Pterocyclus*, referred to *Hymenolaena* (Umbelliferæ), *Carpophora* and *Timaeosia*, which are shown to be founded on published species of *Silene* and *Gypsophila*, and *Hersilea,* which belongs to *Aster.* Of the three remaining genera, *Lepidopelma* is evidently the Euphorbiaceous genus *Sarcococca*, and *Leptanthe* (Boragineae), is *Macrotomia Benthami*, DC. The Endogenous genus, *Stachyopogon*, though unfortunately not really new, is by far the most interesting plant illustrated in the work, as it constitutes a type which, though collected by Wallich, Griffith, and Royle, before Hoffmeister, and by Hooker and Strachey after him, has not yet been published as Himalayan. It is identical with the North American and Japanese genus *Aletris*, formerly referred doubtfully to Irideae, but now by A. Gray and others appended to the imperfectly defined group, Hæmodoraceae, but which seems to differ from Melanthaceae only by an almost evanescent adhesion of the perianth to the ovary. It resembles much in general appearance the genus *Tofieldia*, to which, indeed, one of the Himalayan species was referred by Wallich.

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* The double plates to *Rhododendron argenteum* must be deducted from the total number, 100, as that plant, which is found only in the Eastern Himalaya, was not collected by Dr. Hoffmeister.

With regard to species, as already stated, the total number is estimated by Dr. Klotzsch at 456. Of these he considers 108 to be new, and gives figures of almost all of these. Confining our attention to the Exogens, because Dr. Garcke seems to have printed, without alteration, Klotzsch's MSS. of the Endogens, which was left in a state of readiness for press, we find that out of 93 species figured as new, 39 are identified by Dr. Garcke, without hesitation, with already existing species, and that the very close relationship of 16 others to well known plants is indicated. Dr. Garcke has, therefore, made good use of the Indian collections which he had at hand. Had his materials been more complete, he would, we believe, have been able to identify every one of the species figured with those of other collectors, and, with only one or two exceptions, with already published species.

Dr. Klotzsch had prepared for this work a conspectus of the classification of plants, which, in his opinion, makes it easy for any one who possesses an elementary knowledge of Botany, to determine the class and family to which a plant belongs. We may, perhaps, have an opportunity at some future time of returning to this conspectus, and comparing it with other recent attempts of a similar kind. For the present it may suffice to say, that like all other modes of grouping plants, it presents many exceptions, which make its practical application difficult, and that it does not appear to us to possess any advantages over the classification in common use.

XLI.—MAN'S PLACE IN NATURE.

EVIDENCE AS TO MAN'S PLACE IN NATURE. By Thomas Henry Huxley, Fellow of the Royal Society. London, 1863. Williams and Norgate.

UNDER the title of "Evidence as to Man's Place in Nature"—a subject which has occasioned much controversy during the last few years, as the readers of the Natural History Review cannot fail to be aware—our esteemed colleague, Prof. Huxley, has united three essays, the greater part of which "has been already published in the form of oral discourses, addressed to widely different audiences during the past three years." The first of these treats of the "Natural History of Manlike Apes," the second is devoted to the "Relation of Man to the lower animals," and the last gives us an account of certain recently discovered fossil remains of man, being the well-known fragments of skulls found in the caves of Engis in Belgium, and in the Neanderthal in Germany.

Prof. Huxley commences his first essay with a review of the semi-fabulous *Anthropomorpha* (as Linnæus called them), mentioned by the older authors. He speaks of the "Pongo" of Purchas, the "Orang" of Tulpius, the "Pigmie" of Tyson, and the "Mandrill" or "Boggie" of William Smith, and endeavours to ascertain which of the Anthropoid Apes were really indicated under these names. He then proceeds to the more reliable accounts of modern authorities, and shows the gradual process by which after two centuries and a-half, we have arrived at the clear result that there are "four distinct kinds of Anthropoids: in Eastern Asia the Gibbons and "Orangs; in Western Africa the Chimpanzee and Gorilla."

"Sound knowledge," observes Prof. Huxley, "respecting the "habits and mode of life of the manlike Apes has been even more "difficult of attainment than correct information as regards their "structure."

"Once in a generation, a Wallace may be found physically, "mentally, and morally qualified to wander unscathed through the "tropical wilds of America and of Asia; to form magnificent collections as he wanders; and withal to think out sagaciously the "conclusions suggested by his collections: but, to the ordinary "explorer or collector, the dense forests of equatorial Asia and "Africa which constitute the favourite habitation of the Orang, the "Chimpanzee, and the Gorilla, present difficulties of no ordinary "magnitude: and the man who risks his life by even a short visit to "the malarious shores of those regions may well be excused if he "shrinks from facing the dangers of the interior; if he contents "himself with stimulating the industry of the better seasoned natives, "and collecting and collating the more or less mythical reports and "traditions with which they are too ready to supply him."

Under these circumstances there is still much to be done before a real acquaintance with the habits of the manlike Apes can be arrived at, particularly as regards the Chimpanzee and Gorilla. Our best authorities at present on the Gibbons as observed in a state of nature, are Salomon Müller and Duvancel; on the Orang, Müller and Wallace. As concerns the Chimpanzee and Gorilla, Dr. Thomas Savage—the discoverer of the latter animal—is our only reliable authority. Prof. Huxley gives us full particulars of the habits of the manlike Apes as narrated by these witnesses. He abstains from quoting Mr. Du Chaillu—popularly supposed to be our only authority on the Gorilla—" not because of any inherent impossibility " in Mr. Du Chaillu's assertions, nor from any wish to throw sus-" picions on his veracity, but because so long as his narrative remains " in its present state of unexplained and apparently inexplicable " confusion, it has no claim to original authority respecting any " subject whatever."

Prof. Huxley's second essay, " on the relations of man to the " lower animals " is, perhaps the most important of the three. The weighty fact that " man is identical in the physical processes by " which he originates—identical in the early stages of his forma-" tion—identical in the mode of his nutrition, before and after his " birth, with the animals which lie immediately below him in the " scale," is commented upon by our author as full of significance. Man resembles them " as they resemble one another," and " differs " from them as they differ from one another."

The problem to be solved is the estimation of the amount of difference between Man (considered purely as an animal) and the creatures most nearly allied to him. The great Linnæus, as every one knows, arranged *Homo* simply as a genus of the order *Primates*. Prof. Owen and other authorities whose views are entitled to respect, declare that man must form a separate order of the Mammalian class. Prof. Huxley invokes the aid of a " Scientific Saturnian," entirely free from all human prejudices, and shows that such a person coming to our earth from another planet and calmly discussing this question, would necessarily decide that *Homo* is merely entitled to rank as a member of the same order as the Apes and Lemurs of the same globe. This order, according to Prof. Huxley's views, should embrace " seven families, of about equal systematic value"—namely:

1.	*Anthropini*	containing	Man.
2.	*Catarhini*	,,	Apes of the Old World.
3.	*Platyrhini*	,,	Apes of the New World, except the Marmosets.
4.	*Arctopithecini*	,,	Marmosets.
5.	*Lemurini*	,,	Lemurs.
6.	*Cheiromyini*	,,	Aye-aye.
7.	*Galeopithecini*	,,	Galeopithecus.

"But if Man," continues Prof. Huxley, " be separated by no

" greater structural barrier from the brutes than they are from one " another—then it seems to follow that if any physical process of " connection can be discovered by which the genera and families of " ordinary animals have been produced, that process of connection is " amply sufficient to account for the origin of Man. In other words, " if it could be shown that the Marmosets, for example, have arisen " by gradual modification of the ordinary *Platyrhini* or that both " Marmosets and *Platyrhini*, are modified ramifications of a primitive " stock—then there would be no external ground for doubting that " man might have originated, in the one case, by the gradual modification of a manlike ape—or in the other case as a ramification of " the same primitive stock as these apes."

At the present moment Prof. Huxley is of opinion that there is " only one such physical process of connection with any evidence in " its favour," namely, that suggested by Mr. Darwin. Prof. Huxley is also of opinion that Mr. Darwin has satisfactorily proved *first*, that what is termed " Selection or Selective modification " " must occur " and does occur in nature ;" and *secondly*, that " such selection is competent to produce forms as distinct *structurally* as some genera " are." But in addition to their *structural* differences, species of animals and plants exhibit also *physiological* characters, and the question is, is Mr. Darwin's hypothesis consonant with the observed physical divergences of species ?

As regards one important physiological character it seems that this is not the case. "So long as all the animals and plants certainly produced by selective breeding from a common stock are fertile *inter se*, " we have a fact that the Darwinian hypothesis will not explain. For " what are known as distinct species structurally are for the most " part either altogether incompetent to breed with one another, or " if they breed, their progeny is not fertile *inter se*." Prof. Huxley therefore adopts Mr. Darwin's hypothesis, " subject to the production " of proof that physiological species may be produced by selective " breeding: just as a physical philosopher may accept the undulatory theory of light subject to the proof of the existence of " hypothetical ether ; or as the chemist adopts the atomic theory, " subject to the proof of the existence of atoms ; and for exactly the " same reasons, namely, that it has an immense *primâ facie* probability; that it is the only means at present within reach of " reducing the chaos of observed facts to order ; and lastly, that it " is the most powerful instrument of investigation which has been " presented to naturalists since the invention of the natural system " of classification and the commencement of the systematic study of " embryology."

" But, even leaving Mr. Darwin's views aside," continues Prof. Huxley, " the whole analogy of natural operations furnishes so " complete and crushing an argument against the intervention of any " but what are termed secondary causes in the production of all the " phenomena of the universe ; that in view of the intimate relations "between man and the rest of the living world; and between the "forces exerted by the latter and all other forces, I can see no excuse "for doubting that all are co-ordinated terms of Nature's great pro- "gression, from the formless to the formed—from the inorganic to "the organic—from blind force to conscious intellect and will."

If Man is the modified descendant of a manlike ape or a ramification of the same primitive stock, we might expect to discover remains of ancient races of Man which would exhibit characters intermediate between those of the *Anthropini* and *Catarhini.* Prof. Huxley's third essay is occupied with an examination of what is now known on this subject.

The principal fossil human remains hitherto discovered, are those of the caves of Engis in Belgium and of the Neanderthal near Düsseldorf. These have been pronounced upon competent authority to be of the same epoch as the Mammoth (*Elephas primigenius*) and the Woolly Rhinoceros (*Rhinoceros tichorhinus*). We need not follow Prof. Huxley into his discussion of these remains—particularly as the facts which he relates must be familiar to all readers of this Journal. It is quite sufficient to give the results arrived at after examination of these facts in the words of the author, who sums up the case as follows:—

"In conclusion, I may say, that the fossil remains of Man, hitherto "discovered, do not seem to me to take us appreciably nearer to that "lower pithecoid form, by the modification of which he has, probably, "become what he is. And considering what is now known of the "most ancient races of men; seeing that they fashioned flint axes and "flint knives and bone skewers, of much the same pattern as those "fabricated by the lowest savages at the present day, and that we "have every reason to believe the habits and modes of living of such "people to have remained the same from the time of the Mammoth "and the Tichorhine Rhinoceros till now, I do not know that the "result is other than might be expected.

"Where then must we look for primæval Man? Was the oldest "*Homo sapiens* pliocene or miocene, or yet more ancient? In still "older strata do the fossilized bones of an Ape more anthropoid, or a "Man more pithecoid, than any yet known await the researches of "some unborn palæontologist?

"Time will show. But in the meanwhile, if any form of the "doctrine of progressive development is correct, we must extend by "long epochs the most liberal estimate that has yet been made of the "antiquity of Man."

XLII.—THE NATURALIST ON THE AMAZONS.

THE NATURALIST ON THE RIVER AMAZONS—A RECORD OF ADVENTURES—HABITS OF ANIMALS—SKETCHES OF BRAZILIAN AND INDIAN LIFE, AND ASPECTS OF NATURE UNDER THE EQUATOR DURING ELEVEN YEARS OF TRAVEL. By Henry Walter Bates, 2 vols. 8vo. London, 1863. John Murray.

IN April, 1848, the author of the present volumes left England in company with Mr. A. R. Wallace—" who has since acquired wide fame in connection with the Darwinian theory of Natural Selection," on a joint expedition up the river Amazons, for the purpose of investigating the Natural History of the vast wood-region traversed by that mighty river and its numerous tributaries. Mr. Wallace returned to England after four years stay, and was, we believe, unlucky enough to lose the greater part of his collections by the shipwreck of the vessel in which he had transmitted them to London. Mr. Bates prolonged his residence in the Amazon-valley seven years after Mr. Wallace's departure, and did not revisit his native country again until 1859. Mr. Bates was also more fortunate than his companion in bringing his gathered treasures home to England in safety. So great, indeed, was the mass of specimens accumulated by Mr. Bates during his eleven years' researches, that upon the working out of his collection, which has been accomplished (or is now in course of being accomplished) by different scientific naturalists in this country, it has been ascertained that representatives of no less than 14,712 *species* are amongst them, of which about 8000 were previously unknown to science. It may be remarked that by far the greater portion of these species, namely, about 14,000, belong to the class of Insects—to the study of which Mr. Bates principally devoted his attention—being, as is well known, himself recognized as no mean authority, as regards this class of organic beings. In his present volumes, however, Mr. Bates does not confine himself to his entomological discoveries, nor to any other branch of Natural History, but supplies a general outline of his adventures during his journeyings up and down the mighty river, and a variety of information concerning every object of interest whether physical or political that he met with by the way.

Mr. Bates landed at Para in May, 1848. His first volume is entirely taken up with an account of the Lower Amazons—that is, the river from its sources up to the city of Manaos or Barra do Rio Negro, where it is joined by the large northern confluent of that name—and with a narrative of his residence at Para and his various excursions in the neighbourhood of that city. The large collection made by Mr. Bates of the animal productions of Para enable him to arrive at the following conclusions regarding the relations of the Fauna of the south side of the Amazonian Delta with those of other regions.

"It is generally allowed that Guiana and Brazil, to the north and south of the Para district, form two distinct provinces as regards their animal and vegetable inhabitants. By this it is meant that the two regions have a very large number of forms peculiar to themselves, and which are supposed not to have been derived from other quarters during modern geological times. Each may be considered as a centre of distribution in the latest process of dissemination of species over the surface of tropical America. Para lies midway between the two centres, each of which has a nucleus of elevated table-land, whilst the intermediate river-valley forms a wide extent of low-lying country. It is, therefore, interesting to ascertain from which the latter received its population, or whether it contains so large a number of endemic species as would warrant the conclusion that it is itself an independent province. To assist in deciding such questions as these, we must compare closely the species found in the district with those of the other contiguous regions, and endeavour to ascertain whether they are identical, or only slightly modified, or whether they are highly peculiar.

"Von Martius when he visited this part of Brazil forty years ago, coming from the south was much struck with the dissimilarity of the animal and vegetable productions to those of other parts of Brazil. In fact the fauna of Para, and the lower part of the Amazons has no close relationship with that of Brazil proper; but it has a very great affinity with that of the coast region of Guiana, from Cayenne to Demerara. If we may judge from the results afforded by the study of certain families of insects no peculiar Brazilian forms are found in the Para district; whilst more than one-half of the total number are essentially Guiana species, being found nowhere else but in Guiana and Amazonia. Many of them, however, are modified from the Guiana type, and about one-seventh seem to be restricted to Para. These endemic species are not highly peculiar, and they may yet be found over a great part of Northern Brazil when the country is better explored. They do not warrant us in concluding that the district forms an independent province, although they show that its fauna is not wholly derivative, and that the land is probably not entirely a new formation. From all these facts, I think we must conclude that the Para district belongs to the Guiana province and that, if it is newer land than Guiana, it must have received the great bulk of its animal population from that region. I am informed by Dr. Sclater that similar results are derivable from the comparison of the birds of these countries."

One of the most interesting excursions made by Mr. Bates from Para was the ascent of the river Tocantins—the mouth of which lies about 45 miles from the city of Para. This was twice attempted. On the second occasion—our author being in company with Mr. Wallace—the travellers penetrated as far as the rapids of Arroyos, about 130 miles from its mouth. This district is one of the chief collecting-grounds of the well-known Brazil-nut (*Bertholletia excelsa*), which is here very plentiful, grove after grove of these splendid trees being visible, towering above their fellows, with the "woody fruits, large and "round as cannon-balls, dotted over the branches." The Hyacinthine Macaw (*Ara hyacinthina*) is another natural wonder, first met with here. This splendid bird, which is occasionally brought alive to the Zoological Gardens of Europe, "only occurs in the interior of "Brazil, from 16° S.L. to the southern border of the Amazon valley." Its enormous beak—which must strike even the most unobservant with wonder—appears to be adapted to enable it to feed on the nuts of the Mucujá Palm (*Acrocomia lasiospatha*). "These nuts, which are "so hard as to be difficult to break with a heavy hammer, are crushed "to a pulp by the powerful beak of this Macaw."

Mr. Bates' second volume is mainly devoted to his residence at Santarem, at the junction of the Rio Tapajos with the main stream, and to his account of Upper Amazon, or Solimoens—the Fauna of which is, as we shall presently see, in many respects very different from that of the lower part of the river. At Santarem—"the most "important and most civilized settlement on the Amazon, between "the Atlantic and Para"—Mr. Bates made his head-quarters for three years and half, during which time several excursions up the little-known Tapajos were effected. Some seventy miles up the stream, on its affluent, the Cupari, a new Fauna, for the most part very distinct from that of the lower part of the same stream, was entered upon. "At the same time a considerable proportion of the Cupari "species were identical with those of Ega, on the Upper Amazon, "a district eight times further removed than the village just mentioned." Mr. Bates was more successful here than on his excursion up the Tocantins, and obtained twenty new species of fishes, and many new and conspicuous insects, apparently peculiar to this part of the Amazonian valley.

In the third chapter of the second volume Mr. Bates commences his account of the Solimoens, or Upper Amazon, on the banks of which he passed four years and a half. The country is a "magnifi-"cent wilderness, where civilized man has, as yet, scarcely obtained a "footing—the cultivated ground, from the Rio Negro to the Andes, "amounting only to a few score acres." During the whole of this time Mr. Bates' head-quarters were at Ega, on the Teffe, a confluent of the great river from the south, whence excursions were made sometimes for 300 or 400 miles into the interior. In the intervals Mr. Bates followed his pursuit as a collecting Naturalist in the same "peaceful, regular way," as he might have done in a European village. Our author draws a most striking picture of the quiet, secluded life he led in this far-distant spot. The difficulty of getting news and the want of intellectual society were the great drawbacks—"the "latter increasing until it became almost insupportable." "I was "obliged at last," Mr. Bates naively remarks, "to come to the con-"clusion, that the contemplation of nature alone is not sufficient to "fill the human heart and mind." Mr. Bates must indeed have been driven to great straits as regards his mental food, when, as he tells us, he took to reading the *Athenæum* three times over—"the first "time devouring the more interesting articles—the second, the whole "of the remainder—and the third, reading all the advertisements, "from beginning to end!"

Ega was, indeed, as Mr. Bates remarks, a fine field for a Natural History Collector, the only previous scientific visitants to that region having been the German Naturalists Spix and Martius, and the Count de Castelnau when he descended the Amazons from the Pacific. Mr. Bates' account of the Monkeys of the genera *Brachyurus* and *Nyctipithecus* and *Midas* met with in this region, and the whole of the very pregnant remarks which follow on the American forms of the Quadrumana will be read with interest by every one, particularly by those who pay attention to the important subject of geographical distribution. We need hardly say that Mr. Bates, after the attention he has bestowed upon this question, is a zealous advocate of the hypothesis of the origin of species by derivation from a common stock. After giving an outline of the general distribution of Monkeys, he clearly argues that unless the "common origin at least of the species "of a family be admitted, the problem of their distribution must "remain an inexplicable mystery." Mr. Bates evidently thoroughly understands the nature of this interesting problem, and in another passage in which the very singular distribution of the Butterflies of the genus *Heliconius* is enlarged upon, concludes with the following significant remarks upon this important subject:—

> "In the controversy which is being waged amongst Naturalists since the publication of the Darwinian theory of the origin of species, it has been rightly said that no proof at present existed of the production of a physiological species, that is, a form which will not interbreed with the one from which it was derived, although given ample opportunities of doing so, and does not exhibit signs of reverting to its parent form when placed under the same conditions with it. Morphological species, that is, forms which differ to an amount that would justify their being considered good species, have been produced in plenty through selection by man out of variations arising under domestication or cultivation. The facts just given are therefore of some scientific importance, for they tend to show that a physiological species can be and is produced in nature out of the varieties of a pre-existing closely allied one. This is not an isolated case, for I observed in the course of my travels a number of similar instances. But in very few has it happened that the species which clearly appears to be the parent, co-exists with one that has been evidently derived from it. Generally the supposed parent also seems to have been modified, and then the demonstration is not so clear, for some of the links in the chain of variation are wanting. The process of origination of a species in nature as it takes place successively, must be ever, perhaps, beyond man's power to trace, on account of the great lapse of time it requires. · But we can obtain a fair view of it by tracing a variable and far-spreading species over the wide area of its present distribution; and a long observation of such will lead to the conclusion that new species must in all cases have arisen out of variable and widely-disseminated forms. It sometimes happens, as in the present instance, that we find in one locality a species under a certain form which is constant to all the individuals concerned; in another exhibiting numerous varieties; and in a third presenting itself as a constant form quite distinct from the one we set out with. If we meet with any two of these modifications living side by side, and maintaining their distinctive characters under such circumstances, the proof of the natural origination of a species is complete; it could not be much more

so were we able to watch the process step by step. It might be objected that the difference between our two species is but slight, and that by classing them as varieties nothing further would be proved by them. But the differences between them are such as obtain between allied species generally. Large genera are composed in great part of such species, and it is interesting to show the great and beautiful diversity within a large genus as brought about by the working of laws within our comprehension."

But to return to the Zoological wonders of the Upper Amazon, birds, insects, and butterflies are all spoken of by Mr. Bates in his chapter on the natural features of the district, and it is evident that none of these classes of beings escaped the observation of his watchful intelligence. The account of the foraging ants of the genus *Eciton* is certainly marvellous, and would, even of itself, be sufficient to stamp the recorder of their habits as a man of no ordinary mark.

The last chapter of Mr. Bates' work contains the account of his excursions beyond Ega. Fonteboa, Tunantins—a small semi-Indian settlement, 240 miles up the stream—and San Paulo de Olivença, some miles higher up, were the principal places visited, and new acquisitions were gathered at each of these localities. In the fourth month of Mr. Bates' residence at the last-named place, a severe attack of ague led to the abandonment of the plans he had formed of proceeding to the Peruvian towns of Pebas and Moyobamba, and "so completing the examination of the Natural History of the Ama-" zonian plains up to the foot of the Andes." This attack, which seemed to be the culmination of a gradual deterioration of health, caused by eleven years' hard work under the tropics, induced him to return to Ega, and finally to Para, where he embarked, on the 2nd of June, 1859, for England. Naturally enough, Mr. Bates tells us he was at first a little dismayed at leaving the Equator, "where the " well-balanced forces of Nature maintain a land-surface and a " climate typical of mind, and order and beauty," to sail towards the "crepuscular skies" of the cold north. But he consoles us by adding the remark that "three years' renewed experience of England" have convinced him "how incomparably superior is civilized life to " the spiritual sterility of half-savage existence, even if it were passed " in the Garden of Eden."

We cannot conclude this imperfect notice of one of the most entertaining and instructive books of travel it has ever been our good fortune to peruse, without calling special attention to the illustrative woodcuts, which have not only been well-selected, but admirably executed by the artists employed upon them. The frontispiece, in which our author is represented as beset by a noisy troop of the Curl-crested Aracari Toucans, attracted by the cries of their wounded companion, is one of the best executed scenes of the kind that even Mr. Wolf's prolific pencil has ever produced.

XLIII.—The Mammals of La Plata.

Reise durch die La Plata-Staaten mit besonderer Rücksicht auf die physische Beschaffenheit und die Cultur-zustand der Argentinischen Republik, ausgeführt in den Jahren 1857-1860. Von Dr. Hermann Burmeister. Two vols. 8vo. Halle, 1861.

Dr. Hermann Burmeister, of Halle, has long been known to the world of science as one of the most learned and most active of the present generation of Naturalists. Unfortunately his political opinions, which are naturally enough little in accordance with those of the present *régime* in Prussia, have been put forth with too great vehemence to allow of his remaining quiet in his Professorship of Zoology in the Royal University of Halle. On two occasions already, a term of exile inflicted on him by his Royal Master, under the plausible name of "leave of absence," has driven him from his country. As we learn from the preface to the second volume of the work now before us, Dr. Burmeister has now left Europe for ever, we conclude it is to the same beneficent ruler that European Science is indebted for the permanent loss of one of the foremost in the ranks of living *Savants*.

It is, however, some satisfaction to know that science has gained not a little by Dr. Burmeister's twice-enforced absence in foreign countries. On the first of these occasions he visited the South-eastern provinces of Brazil, and the researches there made led to the publication of his "Systematische Uebersicht der Thiere Brasiliens," (the most complete treatise on the Mammals and Birds of this country yet issued) besides of many other contributions to Zoology and Anatomy, published in the Scientific Journals of the Continent. On the second occasion his four years' "leave of absence" has terminated in the production of two volumes containing the history of his journeyings in the Argentine Republic, and the results of his examination of the peculiar Fauna of that country.

Dr. Burmeister left Europe upon this last expedition in October, 1856. The first station chosen for his residence in the Argentine Republic was Mendoza—situated at the foot of the Andes, near the great pass of Uspallata. The second was Paraña, on the great river of the same name, on the other side of the Republic, and the third Tucuman—the chief city of the northern province of that name. In these three cities and on the road between them Dr. Burmeister passed his time until January, 1860, when he returned to Europe, crossing the Andes to Copiapo, and taking the Pacific steamer to Panama. The whole of Dr. Burmeister's narrative is replete with details of interest to the Naturalist, and we heartily recommend it to our readers' notice. But what we are most concerned with at present is his systematic account of the Mammals of La Plata, which is given at the termination of his second volume, and of which we shall attempt to transfer some sort of outline to these pages.

It should be mentioned that this part of Dr. Burmeister's labours is stated to be only the prelude of a larger work upon the Zoology of the Argentine Republic, which we trust that his permanent residence in the country will enable him to undertake in a more complete manner than he had originally anticipated.

Fifty species of Mammals are recognized by Dr. Burmeister as being found within the limits of the Argentine Republic. In the Brazilian provinces of Rio de Janeiro and Minas Geraēs, traversed on his former journey, Dr. Burmeister obtained evidence of the existence of upwards of 130 Mammals. We see, therefore, at once that in comparison with the southern provinces of Brazil La Plata is poor indeed in species of Mammals. The following list gives the number of species of each order enumerated in Dr. Burmeister's recent work, the Brazilian species described in his "Systematische Uebersicht" being added for the sake of comparison.

	Argentine Republic.	*S. E. Brazil.*
Quadrumana	4	11
Chiroptera	5	31
Feræ	14	17
Marsupialia	2	14
Glires	13	44
Edentata	5	10
Ruminantia	5	5
Pachydermata	2	3
	50	135

The Quadrumana of La Plata only occur in the wooded districts on the Uruguay, Paraña and Paraguay in the north-eastern part of the Republic. They were not met with in the parts of the country traversed by Dr. Burmeister—their organization being evidently ill-adapted for the vast open Pampas, which cover the greater portion of the middle and southern provinces. The three species recorded as being met with in the wooded districts above mentioned, upon what appears to be the not very reliable testimony of Martin de Moussy* are the Brazilian forms *Mycetes caraya, Cebus fatuellus, Callithrix personata* and *Hapale penicillata.*

In Chiroptera also La Plata is poor. Not a single member of the characteristic American family of *Phyllostomatidæ* was met with by Dr. Burmeister during his three years sojourn in the country, although Rengger records the existence of five species of this group in the neighbouring republic of Paraguay. The Bats obtained by Dr. Burmeister were of five species only: *Dysopes multi-spinosus* sp. nov. *D. naso*, *Plecotus velatus*, *Vespertilio isidori* and *Nycticejus bonariensis.*

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* Description géographique et statistique de la Confédération Argentine. Paris, 1860.

The Carnivorous animals are proportionately more numerous in La Plata—the Jaguar (*Felis onca*) occurring on the banks of the great rivers of the Eastern provinces—the Puma (*Felis concolor)* being abundant in the southern, western, and north-western districts, and being everywhere the largest and best known beast of prey. Two other species of true *Felis* are also met with in the Republic. *Felis geoffroyi*—the "*Gato montese*" of the natives—is generally distributed from Tucuman southwards, wherever bushes are found to give it shelter, and is known to range as far as the Rio Negro in Patagonia, where d'Orbigny obtained specimens of it. *Felis payeros*—the "*Gato de las Pampas*" of the natives—a little Cat representing our *Felis catus*—was not obtained by Dr. Burmeister, but there is no doubt of its occurrence in the open Pampas near Buenos Ayres. If La Plata is only moderately provided as regards Feline animals, we must allow that it is better stocked as regards Canines, no less than five feral Dogs being commonly met with in the Republic, two of which are considered by Dr. Burmeister to belong to undescribed species. All the South American *Canidæ* are referable, as Dr. Burmeister has already shown in his Illustrations of the Fauna of Brazil,* to the same section as that which contains the Wolves and Jackals; no true Fox (of the subgenus *Vulpes*) having been as yet discovered there. Amongst the *Canes* of La Plata are representatives of all the three sections into which Dr. Burmeister has divided the South American members of this group, according to characters drawn from the forms of the skull and teeth. These are *C. jubatus* of Desmarest of the section *Chrysocyon*, found on the banks of the rivers near water; *C. entrerianus*, a new species of the section *Lycalopex*, apparently peculiar to the province of Entrerios, isolated in form as in local position by the two great rivers, which form the natural boundaries of that province; and *C. magellanicus*, *C. azaræ* and *C. gracilis* (sp. nov.) of the section *Pseudalopex*. Of these *Canis magellanicus* inhabits the valleys of the Cordilleras, being common near Mendoza. *C. azaræ* occurs only in the most eastern region of the Republic in the province of Buenos Ayres, and *C. gracilis* (the "*Zorro*" of the natives) was discovered by Dr. Burmeister in the bushes of the Pampas near Mendoza, where it preys upon birds and small Rodents. The remaining Carnivores of La Plata consist of two *Mustelinæ* of the genus *Galictis* (*G. vittata* and *G. barbura*), a single Skunk (*Mephitis patagonica*) both these being of genera peculiar to America, an Otter (*Lutra paranensis*) and a Coati-Mondi (*Nasua*) probably the same as the *Nasua solitaria* of Brazil.

Of the peculiar American family of Marsupials, the *Didelphyidæ*, of which such an admirable account is given in Dr. Burmeister's before-mentioned "Erläuterungen," only two species were met with in La Plata, namely *D. azaræ* and *D. elegans*. S. E. Brazil, as we shall see by reference to the "Systematische Uebersicht," produces no less than 14 members of the same group.

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* Erläuterungen zur Fauna Brasiliens. Fol. Berlin, 1856.

Of Rodents, every where numerous, alike in species and individuals, only 13 species, the whole of which belong without exception to forms peculiar to the Neotropical Region, were collected by Dr. Burmeister in La Plata. But as Mr. Darwin obtained 10 species of the family *Muridæ* alone in the same country, it is obvious that many of the smaller species must have escaped Dr. Burmeister's researches. The *Reithrodon typicus* and four species of *Hesperomys* were the only Mice obtained by our author. The Coypu Rat (*Myopotamus coypus*), *Ctenomys brasiliensis*, the Vizcacha, one of the most characteristic animals of the South American Pampas, the allied Rock-Viscacha (*Lagidium cuvieri*), and three Cavies (*Dolichotis patachonica*, *Cavia leucopyga* and *Anoema leucoblephara*, n. sp.) with the Capybara (*Hydrochœrus capybara*) complete the series of Rodents met with by Dr. Burmeister in La Plata.

We now come to the most eminently characteristic group of South American Mammals—the Edentates. The descendants of the gigantic animals of this Order, which peopled the continent in bygone ages, exist at the present time only in the few members of three very distinct families: the Sloths (*Bradypus*), the Armadillos (*Dasypus*), and the Anteaters (*Myrmecophaga*). No Sloth nor Anteater was obtained by Dr. Burmeister in La Plata, though *Myrmecophaga* is stated to occur in the northern wooded districts. The *Dasypodidæ*, however, are represented by five species, all distinct from those of South-Eastern Brazil as enumerated in the "Systematische Uebersicht." Thus we find

In Paraguay.	In Brazil.
	D. (*Priodontes*) *gigas.*
	D. (*Xenurus*) 12-*cinctus.*
	D. „ *hispidus.*
D. (*Euphractus*) *villosus.*	D. (*Euphractus*) *VI. cinctus.*
——— *minutus.*	
D. (*Tolypeutes*) *conurus.*	D. (*Tolypeutes*) *tricinctus.*
D. (*Praopus*) *hybridus.*	D. (*Praopus*) *longicaudus.*
Chlamyphorus truncatus.	

We believe that the species of this group will be found to be for the most part very local, and that the great confusion, which, in spite of the labours of several distinguished Naturalists, still prevails among them, is mainly attributable to the fact of the study of their geographical distribution having been so much neglected. That extraordinary little animal the Pichyciego or Blind Armadillo of the natives (*Chlamydophorus truncatus*),* which is often said to be found in Chili, is entirely confined to the vicinity of Mendoza. Neither that nor any other Armadillo occurs on the western side of the Andes in this part of South America; though farther northward a *Dasypus* of the section *Praopus* is found in the environs of Guayaquil, and has been described by Dr. Burmeister from a specimen in the Museum at Lima under the name *Dasypus hirsutus*.*

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* In a recent part of the Transactions of the Nat. Hist. Society of Halle, Dr. Burmeister, who is now, we believe, resident in Buenos Ayres, has described a second species of this curious form from the environs of Sta. Cruz de la Sierra in Bolivia, which he proposes to call *Chlamydophorus retusus.* See Abh. d. Nat. Gesellschaft zu Halle, Bd. vii.

Ruminants are scarce in La Plata. Though one would suppose the open pampas of South America to be the very place for Antelopes, Sheep and Oxen, not a single hollow-horned Ruminant is found in a feral state throughout the whole Continent. Three species of *Cervus* of peculiar form, and two of *Auchenia*, the feeble representative of the Paleogean *Camelus* are all La Plata can muster. Compare with this the corresponding latitudes of Africa and we shall find perhaps *fifty* species of Antelopes within a similar area, and several representatives of the genus *Bos*. In the present state of our scientific knowledge it is not very easy to explain this, but we have no doubt when the geological changes undergone by the South American continent, and their necessary effects upon animal life have been carefully worked it will become by no means impossible to give an explanation of this and many other at present inexplicable facts of "distribution."

Dr. Burmeister's list of Mammals terminates with a Peccary (*Dicotyles torquatus*) and a Tapir (*Tapirus suillus*), which are the only representatives in La Plata of the Cuvierian Order of Pachyderms.

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* Reise II. p. 347.

Original Articles.

XLIV. — ON THE EMBRYOLOGY OF THE ECHINODERMATA. By Professor Wyville Thomson.

PART I.

1. MY object in the present communication is to collate the various observations which have been made from time to time on the embryology and development of the Echinoderms, and to endeavour to trace, so far as our limited information will permit, some common principle correlating the many modifications of these processes which have been observed within the limits of this remarkable group.

The Echinoderms present in the most marked degree a peculiarity which seems to be only imperfectly indicated in the other invertebrate sub-kingdoms. This peculiarity consists in the successive development from a single egg, of two organisms, each apparently presenting all the essential characters of a perfect animal. These two beings seem to differ from one another entirely in plan of structure. The first, derived directly from the germ-mass would appear at first sight to homologate with some of the lower forms of the ANNULOSA, the second, subsequently produced, within, or in close organic connection with the first, is the true *Echinoderm.*

The extreme form of this singular cycle, in which the development of an intermediate zooid as a separate, independent, living organism, is carried to its full extent, is by no means constant throughout the whole sub-kingdom, although its existence has been established for all the recent orders. In each order it appears to be exceptional, and in certain cases it is known to be carried to its most abnormal degree in one species, while in a closely allied species of the same genus the mode of reproduction differs but slightly from the ordinary invertebrate type. It seems highly probable that even in the same species, the development and independence of the first zooid may be carried to a greater or to a less degree under different circumstances.

2. For an organism such as *Bipinnaria asterigera* which possesses all the apparent characters of a distinct animal, which is developed from the germ-mass, and which maintains a separate existence before the appearance of the embryo, I have proposed the term *Pseudembryo;* and for all appendages which homologate with the whole or with parts of such a pseudembryo, even although they do not assume fully the characters of a distinct animal form, I have proposed the term *pseudembryonic appendages.*

3. I am inclined for the present to follow the example of many of the Continental Naturalists, and to regard the ECHINODERMATA as a distinct sub-kingdom, equivalent in value to the COELENTERATA on one hand, and to the ANNULOSA on the other. With the latter they have certainly in many respects very close relations, but they have maintained through the whole series of geological periods a high

degree of importance and at the same time a singular compactness as a natural group, and consistency in the maintenance of their leading characters. They have passed through a wonderful series of modifications, but their range of modification has been confined within narrow limits.

4. Although regarding the whole Echinoderm group as a sub-kingdom, its sub-divisions, though singularly well defined, are so closely allied in all important structural characters, that I should hesitate in assigning to any of them, at all events to those of the recent forms, more than an ordinal value. Among the fossil groups the Cystideans might form an exception were we sufficiently well acquainted with their structure to pronounce with certainty on their affinities. It is probable, however, that this group may have attained its full development during remote periods whose records have been utterly obliterated.

5. The recent orders are the *Asteridea*, the *Echinidea*, the *Ophiuridea*, the *Holothuridea*, and the *Crinoidea.*

In this classification there is but little serial degradation. The first four orders may be regarded as nearly parallel, but in each order while the external characters usually remain permanent and well marked, there is a wide range in structural differentiation. Among the Crinoids there is so great a tendency to diffusion and to the vegetative repetition of parts, that I think we are entitled to place them at the foot of the series.

As the *Asteridea* present well-marked examples of all the principal modifications of the reproductive process which have been observed among the Echinoderms, I shall commence with an analysis of what is as yet known with reference to the Embryology of this Order.

I.—THE "BIPINNARIA" PSEUDEMBRYONIC FORMS.

6. In the year 1835,[*] in a remarkable little book which contained the germs of many valuable discoveries with reference to the Embryology of the Invertebrata, Professor Sars described under the name of *Bipinnaria asterigera* a singular organism found swimming in the sea off the coast of Norway. At that time Prof. Sars was unaware of its true relations, and imagined that it might homologate with the ciliograde medusæ, but in 1844,[†] in an admirable paper describing another form of Echinoderm-development, he suggested that *Bipinnaria* might be a starfish in an early stage of development, provided with a large swimming apparatus.

7. In 1847[‡] Messrs. Koren and Danielssen published a short paper on the structure of *Bipinnaria asterigera* (Sars), in which they thoroughly established the truth of this suggestion. In October, 1846, the harbour of Bergen was visited by multitudes of these

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[*] "Beskrivelser og Iagttagelser over nogle ved den Bergenske Kyst levende Dyr." Bergen. 1835.

[†] Wiegmann's Archiv. part 2, 1844.

[‡] Zoologiske Bidrag, Bergen. 1847.

zooids, and the Danish naturalists had an opportunity of examining them in detail. The specimens observed were upwards of an inch in length. The special natatory organs were fully developed and a young starfish was attached to the enlarged posterior extremity. Messrs. Koren and Danielssen described in detail and with accuracy the intricate structure of the pseudembryo. According to these observers the body consists of a semitransparent structureless substance, imbedding multitudes of minute granules and scattered calcareous particles, and provided with a delicate layer of longitudinal and transverse fibres, to whose contractions the movements of the body and of the swimming appendages are due.

The largest examples of the attached starfish were five mm. in diameter. They were of a rich crimson colour and had five short arms. The dorsal surface was arched, the ventral flat. In the perisom of the back and sides was imbedded a calcareous annulet which gave origin to a multitude of flattened perforated spines. Usually five or six of these spines started from a minute calcareous turbercle. The sides of the arms were bordered with long spines. The ambulacral feet were long and formed a double row. The oral plates were large and triangular.

Messrs. Koren and Danielssen, however, somewhat misconceived the relations of the various parts. They regarded the pseudostome as a special respiratory orifice for the starfish, while they assigned its own proper functions to the pseudoproct. The subsequent observations of the late Professor Johannes Müller, a naturalist who has thrown by his wonderful researches a flood of light on the Embryology of the Echinoderms, are so much more complete that I shall content myself with giving his results in detail.

8. Müller's first observations were made at Helsingfors, in September, 1847.* The zooids were captured with the towing net in the Sound.

The youngest individuals observed were one-sixth of a line in length and perfectly transparent. The dorsal surface was raised and keel-shaped, the posterior (anal) extremity round and blunt, the dorsal surface curving over on the ventral surface like a hood, and ending about the limit of the posterior third of the ventral surface in a free border. The anterior extremity was prolonged, smooth, and without folds, and beneath it, on the ventral surface, a defined buckler-shaped portion passed backwards, ending in a free border opposite the free border of the hood. In a deep transverse groove between, lay the pyriform mouth. The œsophagus was wide and muscular, the stomach elongated, and passing by a rapid contraction into a narrow intestine, which curved rapidly backwards and downwards, ending in an anal pore about the centre of the ventral curve of the posterior hood. The surface of the zooid was entirely covered with cilia, and by their agency it swam rapidly in the water.

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* "Ueber die Larven und die metamorphose der Echinodermen."—Berlin, 1849.

Two special fringes of long cilia, separated from one another by a deep groove, encircled the whole body, like an elegant scarf. The first of these encompassed the anterior ventral buckler crossing the ventral surface *before* the mouth. The second crossed the ventral surface *behind* the mouth, curved backwards on either side of the hood, and then passing forwards bordered the dorsal surface in a closed circle. The mouth lay in the groove between the fringes, so that one closed circle of the ciliated fringe was completely before, and the other completely behind it. The anal pore was, of course, within the posterior and dorsal fringe.

Zooids double the size were somewhat more flattened. The anterior extremity of the body was prolonged into two fin-like plates, one above, the other below, continuations of the dorsal and ventral surfaces, and bordered by the ciliated fringes. A little later the borders of the dorsal and ventral bucklers were extended, right and left, into symmetrical earlike appendages, greatly lengthening their ciliated fringe. Müller observed in some of these Helsingfors zooids two closed sacs, suspended behind the mouth, and close to the stomach and intestine, with minute spherial granules rotating within them. All the pseudembryos seemed to be of the same species. Müller regarded them as belonging to a different species of the same genus of starfishes, as the form described under the name *Bipinnaria asterigera*.

9. Professor Müller had, unfortunately, no opportunity of observing the large Northern species alive, but he dissected and described specimens preserved in spirits, and sent to him from Copenhagen, by Prof. Steenstrup* and others, of an allied species and of equal size, procured on the coast of Sicily, by Dr. Krohn.†

In the Northern form, *Bipinnaria asterigera* of Sars, the anterior oral extremity is much lengthened, and has a distinct dorsal and ventral sheet of integument, each bordered by a ciliated band, and each ending in a flat-lobed fin. The free-lobed extremity of the dorsal surface is terminal, that of the ventral surface is placed somewhat further back. The lateral appendages, fourteen in number, are crowded in a double line at the posterior, rounded extremity of the body.

In the centre, and within the crown of appendages, a crescentic depression, covered by the ventral fold of the dorsal surface-layer as by a hood, contains the pear-shaped mouth.

As in the young pseudembryo, previously described, the mouth passes into a wide muscular œsophagus, which is connected with a well-defined stomach, occupying a large portion of the rounded posterior extremity of the body, and passing by a narrow constriction into a short intestine, which curves backwards and downwards, ending in a minute anal pore in the centre of the posterior hood. The double ciliated fringe is disposed essentially as in the previously described species.

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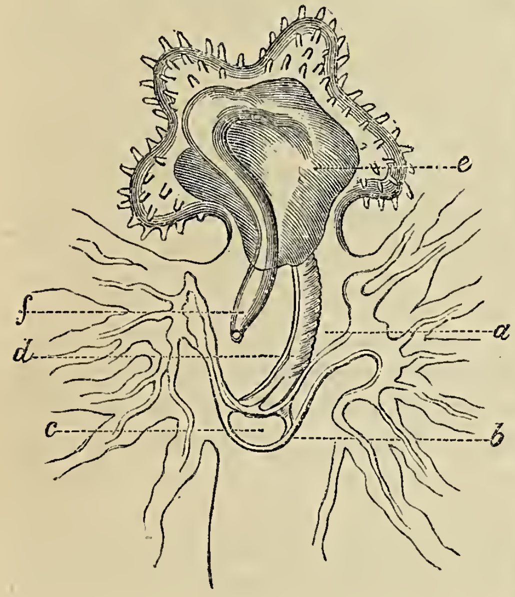
* Op. cit.

† "Ueber die Larven und die Metamorphose der Holothurien und Asterien." —Berlin. 1850.

10. In many of the specimens observed by Müller, the young starfish was already developed, attached to the pseudembryo, on the dorsal surface of the posterior extremity, above the arms.

The dorsal surface of the disk of the starfish was turned towards the body of the pseudembryo, to which it was attached by one of its interradial spaces. The mouth of the starfish, which was still closed by a continuous membrane, and the nascent ambulacra and water-feet, were turned from the pseudembryo, so that the axis of the starfish was oblique to that of the latter.[*] The œsophagus of the pseudembryo entered the body of the starfish on the dorsal surface; near the centre of one of the lower interradial spaces it pierced directly into the stomach, a round well defined sac, which had previously been the special stomach of the pseudembryo, but which was at this stage the common digestive cavity of the starfish and the pseudembryo. The stomach of the starfish then passed by a rapid constriction into the narrow intestine, which ended in the interradial space to the left of that occupied by insertion of the œsophagus, and in the position finally assumed by the anal pore of the mature starfish.



At this period then, the whole assimilative system was common to the pseudembryo and the Echinoderm embryo; but the stomach and intestine were the permanent organs of the Echinoderm, while the mouth and aesophagus were special to the pseudembryo.

11. Müller observed two other openings in the perisom of the starfish, corresponding to points of communication with the body of the pseudembryo—one immediately above the orifice of attachment of the œsophagus, near the centre of the disk, the other immediately beneath that orifice, and closer to the margin. All these three orifices were in the same interradial space. In the Northern specimens Prof. Müller could not satisfactorily make out the relations

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[*] FIG. 1. *Bipinnaria asterigera* (Sars). Ventral aspect of the enlarged posterior extremity of the pseudembryo and dorsal aspect of the echinoderm embryo, with their special and common organs of nutrition.

a. Posterior ventral fold of the dorsal integument of the pseudembryo.
b. Posterior margin of the ventral shield.
c. Pseudostome, in the transverse groove between the dorsal and ventral fringes.
d. Œsophagus of the pseudembryo.
e. Stomach, common at this stage to the pseudembryo and starfish.—(*After Müller.*)

of these openings, but in specimens from Sicily he detected the nascent madreporic tubercle and sand-canal in the position of the second aperture, towards the margin of the disk, and he believed that the two apertures formed points of direct communication between the ambulacral vascular system of the starfish and spaces in the body of the pseudembryo.

The perisom of the starfish was continuous with the body-wall of the pseudembryo. The most definite and permanent connection between the two organisms was by the œsophagus. Koren and Danielssen describe the final liberation of the starfish by the rupture of this attachment by forcible convulsions of the pseudembryo.

12. In the autumn of 1850* Prof. Müller observed at Trieste another form of *Bipinnaria*, which had the advantage of passing through its metamorphoses with great rapidity; he was thus able to trace the earlier stages in the development of the Echinoderm embryo. In all important points of structure this pseudembryo resembled the forms previously described. The appendages were, however, much shorter, and the individuals were extremely minute, the smallest only $\frac{1}{15}$ of a line in length. The starfish began to appear when the pseudembryo was $\frac{2}{10}$ of a line long.

In its earlier stages the animal is of a glassy transparency. It contracts its body forcibly, but no trace of muscular tissue is perceptible. On the sides of the stomach there is at first a mass of granular blastema. This disappears by absorption as the pseudembryo increases in size.

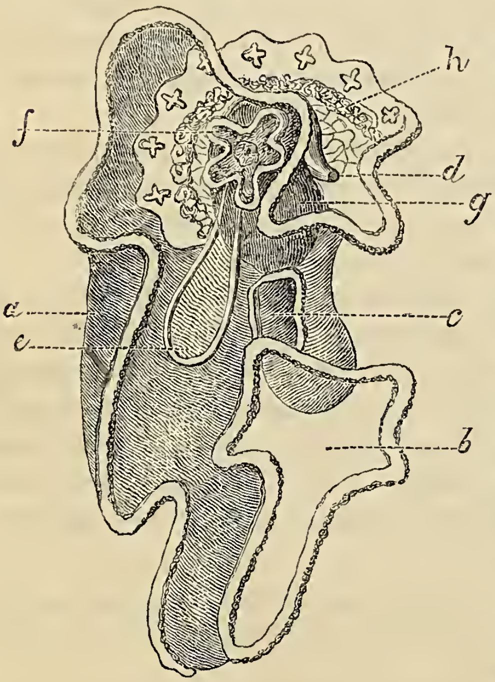

Fig. 2. *Bipinnaria* observed at Trieste.
a. Dorsal integument of the pseudembryo; *b.* ventral shield; *c.* pseudostome;

13. Near the middle of the dorsal surface, a little to the right of the œsophagus, a minute pore appears in larvæ $\frac{15}{100}$ of a line in length. This pore passes into a narrow canal, which penetrates vertically the substance of the dorsal layer, and ends in an elongated sac, ciliated within, and charged with moving corpuscles. The sac lies beneath and to the side of the œsophagus, and sometimes a second portion of the sac passes backwards, and may be seen on the right side of the stomach. The ciliated sac is subsequently undoubtedly in connection with the ambulacral system of the starfish, and the observations of Müller, especially those on the auricularian pseudembryos of the

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* "Ueber die Larven und die Metamorphose der Echinodermen."—Berlin, 1852.

Holothuridea, seem conclusive that this pore and canal are the first indications of the madreporic tubercle and sand-canal of the Echinoderm.

14. Soon after these parts have been formed, a definite hyaline mass, containing multitudes of granules and oil-cells, stretches over the posterior surface of the stomach. It gradually forms a rounded cake, falling over the sides of the stomach, and at length partially involving it like a cowl. This is the nascent perisom of the starfish. At the proximal end of the dorsal canal, at the top of the flask-shaped sac, and at the right side of the stomach of the pseudembryo, a rosette of five minute vascular loops, or cœca, may now be traced. These are the rudiments of the central ring of the ambulacral vascular system. The granular hood passes downwards beneath the integument of the pseudembryo, and covers the back of the stomach as far as the dorsal pore, it involves the pore and canal, and passes round the œsophagus, so that the stomach of the pseudembryo and the vascular rosette are at length included within it, and a raised zone or border passes round the now nearly spherical granular hood. This border is the first indication of the margin of the disk of the starfish, and it defines the dorsal and ventral surfaces of the disk. It passes round the central granular mass, not symmetrically but obliquely, so that, at length, when the rim is fully formed, the starfish looks like a little cap set obliquely on the end of the pseudembryo. Shortly a series of elegantly formed calcareous spiculæ appear round the lobed border, and nascent spines and stars of calcified areolar tissue define more fully the relations of the various parts.

As in *Bipinnaria asterigera*, the dorsal surface of the disk of the starfish is turned obliquely towards the centre of the posterior extremity of the pseudembryo, and the relations of the œsophagus, stomach, intestine and anus, and of the madreporic tubercle and sand-canal, are the same as in the previously described form.

15. Resuming these various observations on pseudembryos of the "Bipinnaria" type, we find that the general structure is essentially the same in all. The earliest stages in the development of these forms have not as yet been observed, but judging from the analogy of the development of the closely allied "Pluteus" pseudembryos of the sea-urchins,* there can be no doubt that, after impregnation of the egg and complete segmentation of the yelk, the whole germ-mass

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d. pseudoproct; *e.* ciliated sac, with corpusculated fluid contents; *f.* rosette of vascular loops, the rudiment of the ambulacral vascular ring of the Echinoderm.

g. Ventral fold of the dorsal integument of the pseudembryo.

h. Border with calcareous spiculæ, indicating the margin of the disk of the starfish. (*After Müller.*)

* Derbès, "Observations sur le mécanisme et les phénomènes qui accompagnent la formation de l'embryon chez l'oursin comestible."—*Annales des Sciences Naturelles*, 1847.

Krohn, "Beitrag, zur Entwickelungsgeschichte der Seegellarven."—Heidelberg, 1849.

is resolved into an oval ciliated animalcule, composed throughout, and consisting entirely, of homogenous structureless sarcode. This sarcode germ increases rapidly in size, at first by the absorption of organic pabulum through the entire surface, as in the simple forms of Protozoa. Special locomotive ciliated fringes are developed, at first simple in their arrangement, but afterwards becoming extremely complicated by the unequal development of the various parts of the organism. As Mr. Huxley has shown in his important analysis of Professor Müller's researches,* these fringes have essentially the same disposition in all Echinoderm pseudembryonic forms. They are transverse to the axis of the body, one girding the body before the mouth, the other behind the mouth and before the anus. In some forms the number of these bands is increased, but in all their arrangement is the same. A special absorbent and assimilative tract is now hollowed out in the sarcode substance, a large buccal aperture with a well marked muscular œsophagus, a stomach, a short curved intestine, and an anal pore.

16. Throughout the greater part of the body and the swimming appendages, the sarcode seems to be consistent and continuous, but in one part of the body (§ 8 and 12), usually in front of the mouth, and extending backwards on one or both sides of the stomach, there is a special cavity lined by a consistent membrane, or by a firmer layer of the sarcode substance, and ciliated.

This cavity contains a special fluid in which definitely formed organic corpuscles are suspended. I suppose these ciliated cavities or cœca must be regarded as representing the vascular system of the pseudembryo, but they are afterwards brought into such immediate and important connection with the embryo that we may rather consider them with special reference only to its development. It is of great importance, however, in determining homologies in different pseudembryonic forms, to remember that the *bipinnaria* consists of two essentially distinct parts, first, of a distorted cylinder of irritable sarcode provided with a locomotive apparatus, and absorbing nourishment through its whole surface, and by a special region differentiated for the purpose; and, secondly, of a sac or cavity containing a corpusculated fluid elaborated by the sarcode zooid. This sac never actually becomes part of the Echinoderm embryo, but it is immediately in connection with its ambulacral vascular system, and the corpusculated fluid contained in it passes into the embryo and circulates in its vascular system. The cavity is then essentially an appendage of the Echinoderm ambulacral system.

17. When these organs and parts are fully formed the development of the bipinnaria as a distinct organism stops. It presents, however, all the essential characters of an independent animal, and may maintain an independent existence and fulfil all the functions of organic life for weeks or months without further change. It has a

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* Annals and Magazine of Natural History, July, 1851.

distinct bilateral symmetry; and, but for the presence of the ciliated sacs it might be conceived to homologate with some low or larval forms of the Annulosa. It is developed from the egg of a starfish under the conditions usual to the development of the embryo, but it is not the embryo of the starfish. Its life is quite distinct from that of the starfish, and it never becomes converted into it by any process of ecdysis or metamorphosis.

It is simply an embryonic appendage* intended like the embryonic appendages of the higher animals, to absorb and elaborate nourishment for the nascent embryo, and it is enabled to assume its independent zooidal form by virtue of the singular properties of the simple histological element of which it is composed.

18. I cannot regard the Echinoderm embryo as in any ordinary sense a *bud* from the pseudembryo. The tissues of the young starfish seem to me to be in all cases formed and arranged according to their special developmental law, within the sarcode pseudembryonic substance. The dorsal vessel with its rosette of cœca which appears so early in the development of some bipinnarian forms cannot, I think, be considered as an inversion of the dorsal integument. The pseudembryo possesses no true integument. The external surface is merely bounded by a firmer layer of the structureless gelatinous substance, and the primordial vessels are hollowed out just as the ambulacral ring is hollowed out in the sarcode substance of species which progress to their definite Echinoderm form without the development of any pseudembryonic appendages.* In the starfish of *Bipinnaria asterigera* the sarcode layer becomes much attenuated over the surface of the disk, but in the Frieste (§ 12.) Bipinnaria the relations of the embryo as a true internal development are sufficiently apparent. In *Comatula*,† this relation is still more evident. The embryo is developed entirely within the body of the pseudembryo without any connection whatever with the perisom of the latter.

II.—The Brachiolaria.

19. Professor Müller describes‡ under this name, a pseudembryonic

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* Professor Carpenter was, I believe, the first to propose this view in a definite form, and I consider it so important as affording a key to the true nature of this singular series of phenomena, that I transcribe his words in full. "We here find the "yolk-mass converted into a structure, which is destined only to possess a transient "existence, and which disappears entirely by the time that the development of the "off-set from it has advanced so far, that it begins to assume the characters of the "permanent organism. This, however, is what takes place in the higher vertebrata; "for the structures first developed in the egg of the bird hold nearly the same rela-"tion to the rudimentary chick, that the 'Pluteus' bears to the incipient Echinus "or Ophiura, or the Bipinnaria to the incipient Starfish."—*Principles of Comparative Physiology. P.* 568.

* Wyville Thomson—"On the development of *Synapta inhaerens* (O. F. Müller.)"—Q. J. Mic. Sc. 1861.

† Wyville Thomson. "On the Embryology of *Comatula rosacea* (Linck.)" Proc. Royal Society, 1863.

‡ "Ueber die Larven und die Metamorphose der Echinodermen."—Berlin, 1849.

form which he obtained at Helsingfors, in 1847. *Brachiolaria* is in many respects closely allied to *Bipinnaria*, but it presents certain structural peculiarities which I regard as of the greatest importance, bringing the Bipinnarian form into relation with some apparently extremely dissimilar forms of Echinoderm development to be described hereafter.

The individuals observed were about 3/4ths of a line in length. The general arrangement of the appendages, of the ciliated fringes, and of the mouth and alimentary canal were essentially the same as in Bipinnaria, but the anterior extremity instead of ending in two lobed fin-like organs, was produced into three tubular appendages, each ending in a minute sucker crowned with small papillae. One of these tubular feet was nearly terminal, rather towards the dorsal aspect of the animal, the other two were turned downwards. The walls of these tubes were highly contractile, the animal using them freely as accessory locomotive organs. The walls were ciliated internally, and the cavity contained a corpusculated fluid. Müller observes, that the cavity of the tubular appendages was continuous with the cavity of the body. There was a dark oval granular patch in the centre between the three arms.

The posterior extremity of the pseudembryo which contained the stomach was much thickened, and formed a five-lobed granular disk placed somewhat obliquely to the axis of the pseudembryo. The dorsal surface of this disk, the surface turned from the centre of the pseudembryo, was arched and gibbous, and was supported by a network of calcified areolar tissue. The ventral surface was flattened, and within it a five-rayed star of vascular cœca might be detected, the rudiments of the ambulacral ring of the starfish.

20. The development of this form was not traced further. Prof. Müller at first believed that the posterior granular disk was the commencement of the perisom of the starfish, but he afterwards came to the conclusion from the analogy of Bipinnaria, that the granular disk and the calcarous network were special to the pseudembryo, and part of its structure, and that the Echinoderm must be expected to arise as a separate bud. I have myself no doubt whatever, after studying the development of *Asteracanthion* (§ 27) that Müller's first view was the correct one. I believe that in this case, only part of the germ-mass was converted into the pseudembryonic sarcode, and that simultaneously with the development of the pseudembryonic appendages, another portion, the granular disk, was being modified into the perisom and tissues of the starfish.

The three hollow arms present all the characters of the ambulacral feet of the starfish, and I think there can be no doubt, that they are in connection with a cavity in the body of the pseudembryo homologous with the ciliated cœca of *Bipinnaria*, and that they are consequently true appendages of the nascent ambulacral system of the starfish. These temporary vascular appendages for locomotion and aeration, naturally assume the form afterwards repeated in the ambulacral water-feet.

21. The body in *Brachiolaria* is thus apparently divided into three portions. The posterior portion includes the common stomach, and consists chiefly of a part of the original germ-mass becoming developed into the Echinoderm embryo. The middle portion contains the mouth and œsophagus, and a ciliated cavity homologous with the special blood-cavity in *Bipinnaria*, and has its sarcode substance extended into the usual appendages bordered by the usual ciliated fringes. The anterior portion is an extension of the ciliated sac into three temporary and locomotive water-feet. The peripheral sarcode layer is continuous over all.

It is unfortunate that it has been hitherto found impossible to determine to what species of starfish, either the various forms of Bipinnaria, or the *Brachiolaria* belong.

III.—ASTERACANTHION VIOLACEUS, ASTERACANTHION MÜLLERI, AND ECHINASTER SANGUINOLENTUS.

22. In this group of star-fishes no free swimming pseudembryo is produced. The eggs are developed in a kind of "marsupium," formed by the curving inwards over the mouth, of the rays of the parent. The eggs pass into this cavity, and before they are finally extruded the young starfishes are fully formed.

23. I observed with care, during the winter of 1860,* the development of the young of *Asteracanthion violaceus* (M. & T.). In this species segmentation of the yelk is complete. After segmentation the germ-mass is at first spherical, finely granular, and still invested by the vitelline membrane. The membrane soon disappears, and within a few hours the embryo seems perfectly homogeneous, regularly oval, and of a delicate flesh colour. I could not detect the slightest trace of cilia on the surface. Four or five hours later, the oval form is still more marked; one end has become slightly dilated, and towards this end there is an accumulation of the denser part of the granular substance. The whole embryo is now invested by a delicate, structureless, gelatinous layer, which is thinner and less apparent toward the narrower and more transparent end of the oval. At the broader end it invests a dark, consistent, granular layer of considerable thickness, formed of oil-globules and compound granular masses and cells, which lines a central cavity filled with a clearer granular semi-liquid, in which there are traces of molecular or ciliary motion.

The embryo now becomes club-shaped, and there is a decided aggregation of the great mass of the granular matter to the thick end of the club, whose transparent investing membrane becomes still more distinct, and the internal granular layer thicker.

24. The transparent investment of the narrow end protrudes one and then two more tubercles, which rapidly declare themselves

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* "On the Embryology of *Asteracanthion violaceus* (M. & T.)"—Q. J. M. Soc. 1861.

three transparent tubular processes, two turned in one direction, narrow, four or five times longer than their width—the other turning in an opposite direction, shorter and thicker.

The investing membrane of the tubes is transparent, delicate, transversely wrinkled, and highly contractile. Each tube is dilated at the free extremity into a slightly opaque, rounded tubercle, which at length takes the form of a sucker, undistinguishable from the ambulacral suckers of the young starfish. The dark granular fluid of the embryo still passes freely into the tubular processes, through their wide, common base.

This common base now contracts somewhat, and lengthens, and this narrower portion of the clavate embryo is separated by a distinct line of demarcation from the broader mass, which gradually assumes a still more rounded and definite form. The whole embryo, during all these changes, increases rapidly in size, partly by the imbibition of water through its walls, and partly by the assimilation of organic matter through its general surface.

The dark upper part is now rounded or widely pentagonal; a thin, transparent, structureless layer, with scattered oil-cells, covers the whole surface. A dark, granular band lines the transparent wall, and the central space, lighter in colour and more transparent, is filled with a mucilaginous liquid, turbid with oil-globules, granules, and compound granular masses.

The lower (anterior) end consists of a wide, transparent contractile tube, prolonged anteriorly into three tubular branches. In the centre, between the branches, there is a dark oval granular patch, but certainly no opening.

The peduncle and tubular appendages now assume their definite and final form.

A slight constriction cuts off the peduncle, into which the processes unite, from the main embryonic mass. The contents of the peduncle and tubes become more and more transparent, till they consist merely of a clear, colourless fluid, in which corpuscles, of the usual form, move and circulate, with the motion peculiar to such particles in the vessels of the Echinoderms, and which would seem to be produced by cilia, though the cilia themselves have not as yet been detected,

The embryo adheres to a foreign body by the suckers at the end of the tubes, and moves along in a peculiar uncouth manner, by the contraction and expansion of the three feet. At this stage the peduncle is attached to the lower surface of the pentagonal rudimentary star-fish, slightly excentrically and midway between two of the rays.

25. The starfish, though now only about once and a-half the size of the peduncle, has asserted distinctly its Echinoderm character.

The angles of the pentagon project still further, forming the rudimentary rays. The transparent external layer becomes thicker, and its scattered oil-cells and endoplasts more numerous and distinct. The inner organized granular layer increases in thickness till only a small central space is filled with granular fluid, while between it and the external layer, or in the external layer itself, small plates of characteristic calcified areolar tissue are irregularly scattered.

The star-like form now becomes still more distinct, a regular series of calcareous plates are developed on the dorsal surface, one large and rapidly expanding plate at the end of each ray, and a smaller one at each of the re-entering angles. On the lower surface, a pair of plates, each with a concave edge towards the point of the ray, and a convex one towards the centre of the star, are formed at the base of each arm, so that the two plates of a pair unite in the centre of the ray, while their free ends meet the free ends of the adjacent plates of the next pairs, forming a calcareous inter-radial angle, projecting into the central space. These plates are rapidly followed by a double row of almost linear plates with double concave edges; which extends towards the point of the ray, leaving between every two pairs, two opposite apertures for the passage of the pedal vesicles.

While these plates are being developed, a tubercle appears on the oral surface at the base of each arm, and a delicate circular vessel forms a slightly raised ring round the centre. This ring, in one part of its course, passes under or blends with, and is lost in the base of the peduncle.

The tubercle at the base of the ray now takes a crescentic form; and shortly the crescent resolves itself into three tubercles, two opposite and occupying either side of the median line of the ray, the other in the centre of the ray and connected with the circular ring by a delicate straight tube. This central tubercle next becomes slightly crescentic, and resolves itself into three tubercles, which arrange themselves like the first three, and in this way a central vessel, proceeding from the ring, follows the development of each ray, with a row of tubercles on either side. These tubercles are shortly developed into suckers like those of the tubular feet of the peduncle, and supported by precisely similar transparent contractile tubes, filled with the same fluid, in which chyle-globules revolve and circulate in exactly the same way. During these changes the peduncle remains unaltered. The embryo stands upon its three feet like a miniature three-clawed drawing-room table.

26. Circulation of granules takes place rapidly in the peduncle and appendages, but pressure applied to the starfish will no longer send the granular contents of the disc into the peduncle, while pressing the peduncle does not inject the general cavity of the star, but only renders turgid the circular canal and the radial ambulacral vessels. A change now begins to take place in the peduncle. It becomes more flaccid, and frequently portions of the tubular feet are separated by deepening constrictions, and shortly all that remains is an inflated sac hanging to the under surface of the disc. The further

development of the disc, however, has in the mean time made the connections of this sac more apparent. The integument has been inverted in the centre of the disc, and the inversion, gradually deepening, has formed a mouth communicating with the digestive cavity, and the vascular ring surrounding the mouth has become more distinct. Five well-marked vessels branch from this ring, each to the end of a ray, and the sac is distinctly seen to join the ring between two of the radial vessels.

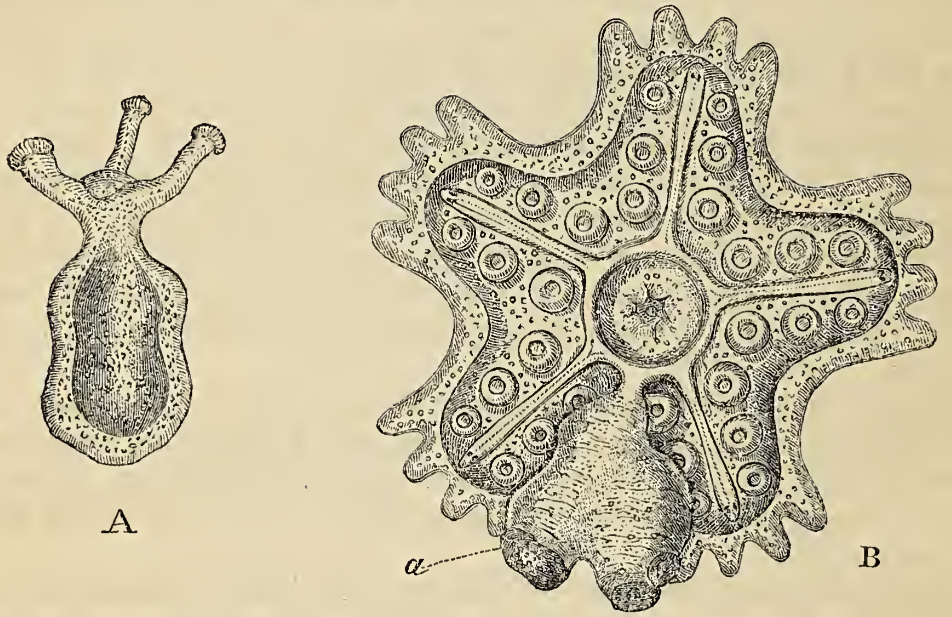

Fig. 3. *Asteracantion violaceus* (M. & T.)

A. Early stage in the development of the embryo, showing the three pseudembryonic water-feet.

B. A further stage in the development of the starfish. *a.* the pseudembryonic appendage becoming absorbed and withering in connection with the central ring of the ambulacral vascular system.

27. As in *Brachiolaria* (§ 19), so in *Asteracanthion*, a portion only of the germ-mass is converted into pseudembryonic appendages. A large part is at once modified into the tissues of the embryo. Even this latter portion is however invested by a layer of sarcode, and, as the organism rapidly increases in size by absorption through the general surface, I think we are entitled from the analogy of other forms, to regard this sarcode investment as a special pseudembryonic absorbent-layer.

This layer is continuous with the wall of the anterior vascular appendage. The branches of this organ are undistinguishable in structure and in function from the ambulacral part of the starfish. A fluid undistinguishable from the chylaqueous fluid of the ambulacral system moves in them with the same characteristic motion. The appendage is closed externally, no communication except by transudation existing between its cavity and the surrounding medium. At first it communicates with the general cavity of the embryo, but afterwards it becomes connected with, and part of, the ambulacral circulating system. When the ambulacral vessels and suckers of the young starfish become fully developed, this provisional vascular tuft withers and disappears, leaving no apparent scar.

28. It is impossible to avoid at once recognizing in the vascular pseudembryonic appendage of *Asteracanthion violaceus*, the three water-feet of *Brachiolaria.* (§ 21.) Even the oval granular mass, whose significance is yet unknown, is in the same position in both.

This pseudembryo of Asteracanthion exactly corresponds with *Brachiolaria* except in one point. The anterior third is attached immediately to the posterior third, while the central part, which in *Brachiolaria* bears the pseudostome and the swimming appendages, is undeveloped. A special assimilative apparatus seems to be unnecessary. The young are crowded round the mouth of the parent, imbedded in a slimy mass of half digested food, to portions of which they are generally attached, at first by their peduncles and afterwards by their water-feet. Swimming appendages are of course equally unnecessary. In all this group of embryo the sarcode layer is by no means so transparent as in the swimming forms. It is loaded with very minute oil globules, and has the dulled transparency of ground glass, resembling the material of the young of some internal parasites.

29. Prof. Sars* describes the embryogeny of *Echinaster sanguinolentus*, O. F. Müller (= *Echinaster sepositus*, Retz.; *E. oculatus*, M. & T.; and *Cribella oculata*, Forbes.) This species produces its young in a marsupium, in the manner already described in *Asteracanthion violaceus.* The pseudembryonic appendages had nearly the same form as in the latter species, but Prof. Sars describes them as at first placed towards the ventral aspect of the disk of the starfish, and afterwards passing over towards the dorsal surface, and, finally, disappearing in the position of the madreporic tubercle. He imagines the madreporic tubercle in starfish to represent the scar of the former attachment of the pseudembryonic peduncle, and he regards this peduncle as the equivalent of the stalk in Crinoids. I think there can be little doubt that this view of Prof. Sars, with reference to the madreporic tubercle, is a fallacy. The pseudembryonic vascular appendage represents the internal ciliated sac of *Bipinnaria*, and not the dorsal pore and tube, and from Müller's observations on the Trieste *Bipinnaria*, the ciliated sac seems to be connected with the ambulacral ring, independently of the dorsal tube, though in close connection with it.

However, as the sand-canal is essentially a portion of the ambulacral system of the starfish, and in direct communication with that system, it seems by no means improbable that in those forms, such as *Bipinnaria asterigera*, in which the dorsal surface of the starfish is attached to the pseudembryo, the communication between the ciliated cavity of the pseudembryo and the ambulacral system of the embryo may exist at or near this point, indeed this appears to be the case, in some instances, from Müller's observations on the Bipinnaria from Sicily. *Near* the madreporic tubercle more probably than *at* it, for the dorsal pore, with its calcareous ring, is undoubtedly the origin of the madreporic tubercle, and whenever this pore exists (Trieste *Bipinnaria*, *Auricularia*, *Tornaria*, &c.), it appears always to pass through the perisom, and open to the outside. It seems to stand in the same relation to the ciliated sacs of the pseudembryo, which it afterwards maintains to the ambulcral system of the starfish.

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* Wiegmann's Archiv. Part 2, 1844; and "Fauna littoralis Norvegiae."—Christiania, 1846.

30. In *Asteracanthion violaceus* (§ 26.) this pseudembryonic appendage is undoubtedly perfectly distinct from the madreporic tubercle, and, as we shall see hereafter in discussing the development of *Comatula*, the stem of the Crinoids is simply a tegumentary appendage, and its insertion in no way homologates with the madreporic tubercle in the other Echinoderm groups.

31. Dr. W. Busch* describes the embryology of, if his determination be correct, the same species under the name of *Echinaster sepositus*—and he distinctly describes the disappearance of the peduncular appendage on the ventral surface of the disk. Busch, however, describes a mouth in the centre of the peduncle, between the vascular branches. I have little doubt that this is an error of observation. The oval granular prominence, whatever be its function, which occurs in this position in all these forms, is clearly the equivalent of the oval patch in the same situation in the Brachiolaria, where it co-exists with the pseudostome.

32. Sars describes† a closely analogous mode of reproduction in *Asteracanthion Mulleri* (Sars), but in this species the peduncle seems to be distinctly attached to the ventral surface of the disk.

33. Desor‡ describes a mode of development slightly different in detail, but on precisely the same plan in an American starfish. In this case the peduncle is simple, and depends excentrically from the oral surface of the embryo. Desor regards the peduncle as a vitelline sac, and believes it to be in direct connection with the digestive system, into whose general cavity its contents are gradually absorbed. Agassiz§ confirms Desor's observations, but gives no definite opinion on the relations of the temporary appendage.

34. Müller describes|| a minute form which he observed at Nice, in 1849, and which comes doubtfully under this category. The spe-

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* "Beobachtungen über Anatomie und Entwickelung einiger wirbellosen Seethiere."—Berlin, 1851.

† Op. cit.

‡ Proc. Boston Soc. of Nat. Hist. February, 1848.

§ "Lectures on Comparative Embryology."—Boston, 1849.

|| "Ueber die Larven und die Metamorphose der Holothurien und Asterien."—Berlin, 1850.

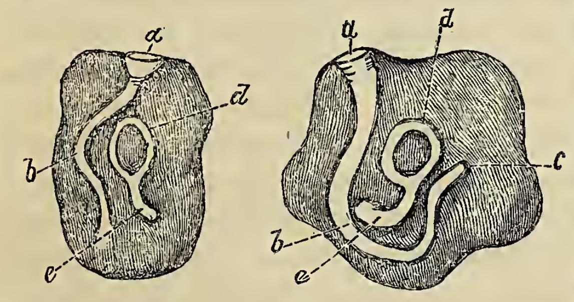
cimens described were only from 1/10th to 1/5th of a line in diameter. They were discoid, the upper surface arched, the lower flat, and from the centre of the lower surface a large open œsophagus depended. These zooids might have been taken from their form for young pulmograde Medusæ, only they moved by the action of cilia. Several cœcal appendages, ciliated externally, and varying in number in different individuals were attached to the lower surface of the disk, and round the margin were distributed from two to four extremely minute open tubes.

The stomach, ciliated within, was placed in the centre of the disk. Further advanced the disk became octagonal and crenated. No calcareous particles were detected. Müller suggests, that this may have been an early stage in the development of *Asteracanthion tenuispinosus*, a species with from six to eight arms, and three or four madreporic tubercles.

IV.—PTERASTER MILITARIS AND ASTERACANTHION GLACIALIS.

35. Another, and a very distinct form of development was observed by Messrs. Koren and Danielssen, in a well-known Northern species.*

In *Pteraster militaris* (M. & T.) a delicate membrane, supported by the spines above the surface of the perisom, and perforated near the centre for the anal aperture, forms a tent-like marsupium over the whole of the dorsal surface of the disk. In this cavity from ten to twenty eggs are hatched on each individual, and the embryos remain until they have assumed their definite radiate form. The authors were unable to trace the earliest stages in the development of the pseudembryo. In the youngest individuals observed it had attained its perfect form, and some indications were visible of the special organs of the young starfish.† The pseudembryo (Fig. 4, A.) was oval and somewhat flattened, with a slightly undulated margin. At the anterior extremity, a large round buccal aperture led into a straight narrow intestine, which traversed the long axis of the body somewhat towards one side, and appeared to be lost near the posterior extremity in the granular substance. Near the centre of the body, a rounded mass of darker granules was encircled by a delicate vascular



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* "Fauna littoralis Norvegiae," Andet Hefte.—Bergen, 1856.

† FIG. 4. *Pteraster militaris* (M. & T.) *A*. Pseudembryo, *a*. pseudostome. *b*. intestine. *c*. vascular cœcum indicating the sand-canal and madreporic tubercle. *d*. central vascular ring of the ambulacral system. *B*. A farther stage showing the outline of the Echinoderm embryo. *a*. pseudostome. b. pseudocele. *b*. pseudoproct, *d*. central ring of the ambulacral system of the star-fish. *c*. nascent sand-canal and madreporic tubercle. (*After Koren and Danielssen.*)

ring, with a cœcal process passing to the surface on the dorsal aspect. The central dark mass indicates the position of the stomach of the starfish, the circular vessel of the ambulacral ring, and the vascular cœcum of the sand canal.

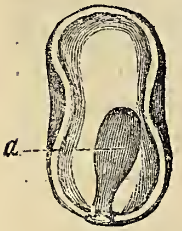
The nascent organs of the starfish were entirely unconnected with the alimentary system of the pseudembryo.

In an individual slightly farther advanced the body had become pentagonal (Fig. 4, B.), the ambulacral ring, and the included granular mass were more marked. The provisional mouth was still distinct near one of the salient angles, and the intestine could be traced curving round the outside of the vascular ring, and ending by an anal pore on the dorsal surface of the rays.

The internal organs of the starfish now progressed steadily in development, inclosed in the structureless granular substance of the pseudembryo, whose alimentary canal still remained well defined and entire. Five blunt rays gradually became studded with spines and paxillæ, and were termined by red eye-spots. The permanent mouth of the starfish was defined in the centre of the ventral surface, though still closed by a membrane, and at length the ambulacral vessels might be detected.

The granular sarcode-substance characteristic of the pseudembryo now seemed to thin off the surface. The provisional alimentary canal gradually disappeared, though it was only after the extrusion of the embryo from the *marsupium*, that the permanent mouth of the starfish came into play by the absorption of the occluding membrane.

36. I have much hesitation in associating with that of *Pteraster militaris*, the pseudembryo of *Asteracanthion glacialis* (L.), briefly described by Dr. Busch.* The author only had it in his power to observe this form during a single day, and his fragmentary observations left it in doubt whether the pseudembryo was progressing towards the "Bipinnaria" type, or towards some simple form of development. The figures of the pseudembryo resemble somewhat those of the early stages of *Pteraster militaris*. I briefly abstract Dr. Busch's description, in anticipation of further information. When the process of segmentation is complete, an oval germ escapes from the vitelline envelope. A day after extrusion, a dusky rounded mass may be observed in the centre, the first indication of the stomach. A broad yellowish border now becomes defined, passing right round the body, and, at the same time, the digestive cavity elongates and stretches to the free border, where it ends in a large round mouth. The body now becomes lengthened, and clear cells appear at intervals over the surface.†



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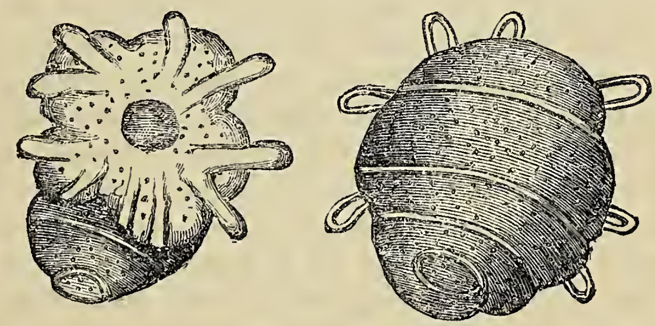
* Op. cit.

† Fig. 5. *Asteracanthion glacialis* (L.) Pseudembryo. *a.* Pseudembryonic assimilative cavity. (After Busch.)

The form of the body changes to a four-sided prism, the anterior surface separating from the posterior, and thus forming the lateral surface, which at first are pretty regular. Shortly the border curls up, so that a hollow is formed on either side; and, beyond this point, Dr. Busch was unable to pursue his observations. No ciliated fringes were as yet defined on the surface of the zooid.

V.—"Vermiform Larva."

37. This form was observed by Professor Müller at Nice, in the summer of 1849. It was $\frac{3}{10}$ of a line in length, and slightly narrower; annulose in appearance with four transverse furrows dividing the dorsal surface into five segments. The second and third segments were the largest; the first and last were extremely minute. The dorsal surface was opaque and brownish with patches of dark pigment. The ventral surface, as far as the fourth segment, was colourless, and shaped like a five-rayed star. Ten long colourless vascular cœca were arranged symmetrically, a pair on each ray, evidently the first row of ambulacral feet. The dorsal transverse grooves terminated on the ventral surface in the angles between the rays. The dorsal perisom was supported by a close network of calcified tissue, and on the ventral aspect there was the usual pentagonal ring of oval plates. The posterior segments projected behind the star. The centre of the last segment presented a slight depression, but Müller was unable to determine with certainty whether there was an opening in this position.*



a. *b.*

Rather further developed, the dorsal surface had assumed the form of a pentagonal disk, and a soft appendage, probably a respiratory tentacle, projected from each of the salient angles. Müller describes individuals still farther developed, which he observed at Trieste in the autumn of 1850, but they show no change of special interest.

38. I shall now briefly state the general conclusion to which I have been led by the careful study of the various aspects of this singular process.

The only character which all the Asterid germs appear to possess in common, is the fusion of the whole, or of a part, of the germ-mass into a mass or layer of the peculiar structureless histological element, which has been called "sarcode." This mass or layer, possessing, as distinguished from the true embryo, a distinct individuality, and performing its functions entirely and maturely while the rudimentary tissues of the embryo are being laid down.

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* Vermiform larva of a star-fish—*a.* ventral, *b.* dorsal aspect. (After Müller.)

I cannot agree with Prof. Carpenter, Prof. Schultze, and others, that "sarcode" is simply equivalent to protoplasma, or elaborated organic pabulum. It undoubtedly possesses special vital properties, and is capable, without the intervention of any accessory organization, of performing active vital functions. To take an example. The auricularian pseudembryo of a Holothuria is formed entirely of this absolutely structureless material, but, according to its special developmental law, calcareous spiculæ, and wheels of complex form, are produced imbedded in its substance—at first, a minute closed hollow calcareous particle appears, imbedded in the transparent sarcode; this gradually lengthens, enlarges, and assumes a complicated form. How is this effected? The calcareous particles themselves are, of course, utterly inert. It can scarcely be said that the calcareous tube *enlarges itself* by resorbing its own walls and adding to them. It is equally inconceivable that the power of re-arrangement exists in the infinitesimally divided organic matter, combined with the lime in the wall, if there be any such. The wall must be built from the outside by an external agent, and an agent of great vital activity. Again, the calcareous matter is derived from the sea-water in which it exists in the form of an almost infinitely weak solution. In the sarcode layer, cells, which are universally recognized as "calcareous glands," make their appearance in the neighbourhood of rapidly forming calcareous tissue. The sarcode has collected and concentrated a quantity of the infinitely weak calcareous solution, and has thrown a cell-wall round it to retain it for future use. Again, organic matter diffused in the sea is exposed to the absorbent surface of the sarcode zooid. The organic matter is assimilated, its elements are recombined, and forthwith a globule of oil is wrapped up in a cell-wall and laid aside. This rudimentary gland is not, according to this view, made *from* the sarcode as from a blastema, but it is made *by* the sarcode as by an active vital agent.

I by no means imagine that these processes are performed by any hitherto undetected form of organization. I am inclined to believe, on the contrary, that every particle of sarcode entering into the composition of any organized being, whether it exist in mass or diffused among special tissues and organs, is potentially the whole being, and may, under favourable circumstances, reproduce an organism, a repetition of the organism from which it was detached; (whether as the essential element of a bud, of an ovum, or of a spermatozoon).

I intend entering more fully into this subject in a future part of this paper. I merely mention these points at present in order to explain fully the kind of vital activity which I think I am entitled to claim for the sarcode element.

39. At all events it must be generally admitted that we have many instances in the sub-kingdom PROTOZOA of the effective performance of the functions of assimilation, of respiration, and of automatic motion in beings formed of homogeneous sarcode alone, without the differentiation of any special tissue or organ. Consequently, a layer of this substance, investing the nascent embryo of a higher organism, may answer the same purpose, though perhaps in an inferior degree, as if the germ were provided with special provisional organs for the performance of these functions.

40. I have already stated that *Bipinnaria* consists essentially of two parts, an absorbent, assimilative, and locomotive, sarcode zooid; and a ciliated sac, containing a special nutrient fluid, elaborated by the sarcode zooid, and in immediate connection with the ambulacral vascular system of the Echinoderm embryo. In *Bipinnaria* (§§ 6—18) the special organs of nutrition and locomotion of the pseudembryo are fully developed, and the vascular sac is comparatively insignificant. In *Brachiolaria* (§§ 19—21) both sets of organs are well developed, and they are nearly balanced in bulk. In *Asteracanthion violaceus* (§§ 22—27) the organs and appendages special to the pseudembryo, the pseudostome and the pseudocele, are in abeyance, and the zooid is reduced to a sheet of sarcode investing the germ, and a peculiar modification of the ciliated sac.

In *Pteraster Militaris* (§ 35) the zooid is likewise reduced to an investing sheet of sarcode, a large portion of the germ-mass being converted immediately into the embryo, but the ciliated sac is gone, and we have once more the provisional mouth and alimentary canal imbedded in the sarcode wall.

Unfortunately the observations on the "Vermiform larva" of Müller are as yet too imperfect to admit of any satisfactory determination of its relations.

XLV.—A VISIT TO THE ANCIENT SHELL-MOUNDS OF SCOTLAND.

By John Lubbock, Esq. Pres. Ethn. Soc. F.R.S. &c. &c.

IN our April number we mentioned that the Rev. George Gordon of Birnie, near Elgin, had found on the shores of the Moray Frith several shell-mounds, more or less resembling the kjökkenmöddings of Denmark. Since that time I have been down to Scotland, in order to visit these shell-mounds, and Mr. Gordon has had the kindness to show me all those which are as yet known to him. He also pointed out to me the remains of a lake dwelling, discovered by Dr. Grigor of Nairn, in the "Loch of the Clans," about five miles from that town. This little lake has been partially drained, and the remains of the piles are thus laid dry; the ground was still, however, at the time of my visit, too marshy to permit a satisfactory examination of the place. During the summer, however, Dr. Grigor will, I hope, make some researches at this spot. In the old bed of the same lake is a small " Crannoge," about ten feet high and eighteen yards in diameter. It is composed of stones, bound together by beams of wood, and close to it I found a bone awl. From the same place Dr. Grigor has obtained part of a stone vessel and two oblong stones, each about four inches long and half an inch thick; one is rounded at the corners, the other is angular; they seem to have been used as polishers. A very similar Crannoge was found many years ago in the Loch of Spynie.

The first of the shell-mounds which we visited was at Bannat Hill, near Burghead, on the coast of Elgin, and close to the west side of the Alves and Burghead Railway. It was a small heap, nearly circular, and about six yards in diameter, resting on a nucleus of sand, which is at the middle about four feet high, and gradually slopes towards the ridges. The shelly layer is nowhere more than a foot in thickness, and is quite at the surface. Periwinkles (*Littorina littorea*) are most abundant, but there are also many Limpets (*Patella vulgata*), some specimens of Purpura lapillus, and of Mussels (*Mytilus edulis*), which, however, are so disintegrated and broken up that I did not find one perfect valve. We observed also many fragments of crabs' claws. As usual, many of the stones were broken by the heat of the fire, and at a little distance I picked up the butt end of a flake.

Fragments of bone were numerous, but, as usual, very fragmentary. We determined only the ox, sheep, and pig. We did not find a trace of pottery.

Near this shell-heap, but on the other side of the railway, are two others, very similar to the first. In one of these we found a piece of stag's horn, and some fragments of bone, probably referable to the same animal. Remains of the ox, sheep, and pig were as abundant as before.

In addition to the shells already mentioned, we found a few Cockles. There were numerous traces of fire, but I found no pottery nor stone implements. Close by, however, I picked up a minute fragment of flint.

From this shell-mound we obtained three small implements of bone, with a single exception the only ones which have been as yet discovered in the Scotch shell-mounds. The first is about two inches and a-half long, but the point is imperfect. The head is clumsy, rounded, and a little flatter at the sides. The second is more primitive in character; it is an awl or pointed instrument, formed out of a long bone split open; the length is rather more than three inches, of which the upper half is brought to a point, while at the lower half the natural form of the bone is left unaltered. The third is a small bit of bone about two inches long, and brought to a point at one end. It may perhaps be doubted whether this was intended as an instrument; its pointed end might possibly have resulted from the manner in which the bone was cut open for the sake of its marrow.

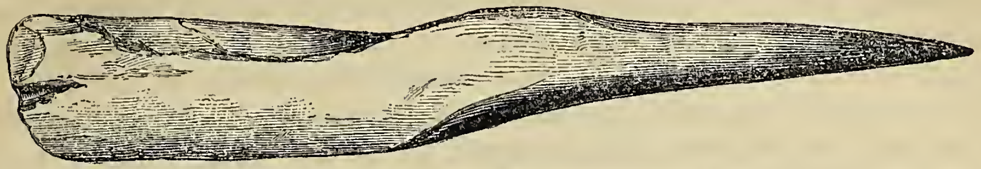

Fig. I.

Between Burghead and Findhorn the coast is a shingly plain, elevated only a few feet above high-water mark, and divided into about twenty ridges, which, though somewhat irregular, run approximately parallel with the coast. They are from three to ten yards broad, occasionally bifurcate, and are from ten to fifty yards apart. The coast has a somewhat desolate appearance, the shingle being for the most part quite bare, though in places there are large patches of gorse and heather. Along this stretch of coast Dr. Gordon pointed out to me several small accumulations of shells, besides which there were some places where we found traces of fire, but no shells, or, at least, very few. The largest shell-mound which we saw in this neighbourhood was near Mutton Hole Farm. It was on a hillock about six feet high and sixty-five yards in circumference. The mound itself was composed of stones and sand, covered by a layer of shells. This layer was only a few inches thick. We found no pottery, and bones seemed to be much rarer; we did not, however, dig much in this shell-mound.

I picked up a small fragment of a bronze ring, and we found also several minute bits of flint of irregular shapes.

Though the species of shells present in these shell-mounds is nearly the same, still the proportions of each kind vary very much. In the first heap we examined, periwinkles were by far most numerous and cockles were almost entirely absent; in some of those nearer Findhorn, on the other hand, as, for instance, in the one near Mutton Hole Farm, cockles were the predominating shell, and next to it the Mya was perhaps the most frequent. In this neighbourhood, again, oysters seemed to be altogether absent, while with the periwinkle they form the main part of the kjökkenmödding near the old margin of Loch Spynie.

This small lake, which is bisected by the Elgin and Lossiemouth Railway, at present occupies but the central portion of the plain which it once covered. Indeed, it is evident that the high land to the north was once an island, and that Loch Spynie must then "have been an arm of the sea, open in breadth at the east nearly "from the Hill of Garmach to the headland behind Lossiemouth, "and stretching westward over the plain till it again joined the "Frith at the town of Burghhead. The general elevation of this "tract does not exceed four feet above the level of the sea." * Owing

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* A Survey of the Province of Moray.

however to the violent storms from the east and north-east, the shingle on this part of the coast is not only travelling continually westwards, but is in some places actually driven to a height considerably above that of high water. Dr. Gordon showed me some boulders which had within the last thirty years been taken out of the harbour and thrown down at its mouth, and which, carried westwards by storms, accumulated so as to form a bank in some places as much as twelve feet above high-water mark. It appears that a similar cause in ancient times, carried the shingle along the north coast of the Island, and so gradually blocked up the eastern entrance to Loch Spynie. In the "Survey of the Province of Moray," it is stated that "the irruption of the Godwin sands happened in the tenth century, in the reign of Malcolm III., and from Buchanan's history it might be inferred, that its effects were not limited to that quarter alone, but must have extended over all the eastern coast of Britain." Again, "another storm, extremely violent also, happened in the 13th century, upon the eastern coast of Scotland." In the year 1266 a great wind arose from the north, on the eve of the Feast of the 11,000 virgins, and the sea broke in, and many houses and villages were overwhelmed. "There never was such a deluge," says Fordun, lib. x. c. 22, "since the times of Noah." To one or both of these irruptions our author thinks that the separation of Loch Spynie from the sea on this side may with some probability be ascribed. At any rate, we may perhaps assume that this change did not take place later than the middle of the 13th century; though from the whole appearance of these ancient beaches, I should be inclined to believe that the sea has shut itself out from the land by the continual operation of existing forces, and that the change in geographical relations was by no means the result of a mere occasional disturbance. The communication with the sea at the west appears also to have been gradually cut off. The water of Loch Spynie was however then probably brackish, and the more so as at that time the Lossie appears to have run into it. At what period the river was turned into its present course, and whether by accident or design, does not appear to have been satisfactorily ascertained.

At the close of the 14th century, we find the Lord Bishop Alexander Bar protesting against the Earl of Moray and the Burgesses of Elgin, respecting the right of fishing and of the harbour, among other reasons, because "The Bishops of Moray, our predecessors, "with the knowledge and sufferance of the Earls, and of the Burgesses of Elgin, had, and were in the use of having, the inhabitants "of the village of Spynie, in the name and right of the Bishops of "Moray, fishers of seafish, sailing with their wives and families from "Spynie to the sea, and returning in their boats with the fishes to "the said harbour." Still as Dr. Gordon well observes, "the size "and abundance of the oysters found in the shell-mounds at Brigzes "prove that, when they were dredged in the Loch of Spynie, the

" tide flowed in and out with a depth and freedom and a breadth of
" surface altogether inconsistent with the contracted outlet which
" seems to have been the grounds of a contest between Bishop Bar
" and the Earl Moray in 1383."

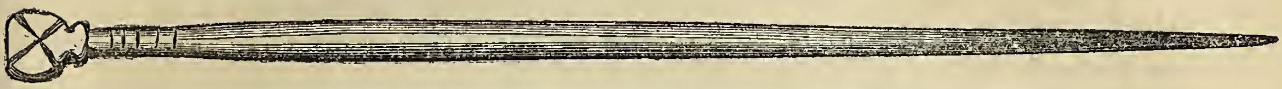
The shell-mound in the wood on Brigzes farm, lies exactly on the edge of the old Loch margin, and being now several miles from the present sea shore, no doubt belongs to the time when Loch Spynie was an arm of the sea.

The mound itself is double, the two portions being, according to a measurement made by Dr. Gordon, respectively eighty yards by thirty, and twenty-six yards by thirty. The depth of the shelly layer varies from about two feet to six inches, and it is covered by turf, &c. It is a good deal mixed with black earth and rests on sand. Periwinkles and oysters, in nearly equal numbers, form the great bulk of the deposit. Oysters are still found apparently on the spots where they lived, in the bed of the old Loch, and doubtless go back to the time when it was freely open to the sea both to the east and to the west. The partial closing of the communication would render the water too brackish for Oysters, especially if, as seems probable, the river Lossie at that time ran into Loch Spynie. At present, however, Dr. Gordon tells us that the oyster is not to be found on these coasts except in a few sheltered spots, as for instance at Cromarty, Altirlie, and Avoch. The oysters in the shell-mound are fine specimens. Next to them in point of numbers come the cockle (*Cardium edule*), which forms perhaps two or three per cent of the whole mass, and the muscle (*Mytilus edulis*), which seemed to me to be rather less numerous. The other species found, though in comparatively small numbers, are the Buccinum undatum (whelk), Tapes decussata, T. pullastra, Natica, Patella vulgata, Purpura lapillus, Littorina littoralis, Trochus, Anomia, and Serpula. One of these (*Tapes decussata*) is specially interesting. "Its re-
" mains hold the fifth, if not a higher place, in the shell-mound at
" Brigzes. It is not now known in the Moray Frith, and the most
" northerly locality where it is now found alive is the coast of Car-
" narvonshire. It seems to form a striking exception to the rule.
" While the other species, that are now extinct on our shores, are
" withdrawing to the north, and are found alive only towards the
" Arctic Circle, this species, once frequent but not now known with
" us, has withdrawn in the opposite direction to a warmer latitude."

Dr. Gordon made the above statement as to the present geographical range of Tapes decussata, on the authority of Mr. Robert McAndrew, who, in his memoir "On the geographical distribution of Testaceous Mollusca in the North Atlantic and neighbouring seas," gives Carnarvonshire as the northern limit of that species on our coasts. On the other hand, it has been found by Bean at Scarborough, in Northumberland by Alder, and even in Skye and Zetland by E. Forbes. In the latter case, however, the rather unusual expression is used, "buried in gravel at low water mark." It is just possible that these northern specimens may have been dead. However this may be, and even if we must ascribe to T. decussata a more northern range than that which Mr. McAndrew appears to assign to it, still the interesting fact remains, that it is no longer to be found in the Moray Frith nor on the neighbouring shores.

I engaged a labourer to assist me, and spent about four hours in the examination of this mound. Marks of fire were abundant, but I found not a single bone, not a trace of pottery, nor an implement of any kind. In this respect Dr. Gordon's experience agrees with mine. The absence or rarity of bones, may perhaps be attributed to the insular position of this shell-mound, and at any rate we may certainly infer, that meat was a luxury seldom enjoyed by these "Mound-builders." The absence of pottery and of implements is still more puzzling. In the Danish Kjökkenmöddings, fragments of rude pottery are not uncommon. During my visit to the shell-mound at Havelse with Prof. Steenstrup and Mr. Busk, we obtained nine rude axes, besides flakes and other fragments of flints. Again, implements and fragments of implements occur in similar abundance on the sites of the ancient Swiss Lake habitations. I was therefore surprised and, it must be confessed, a little disappointed to find these Scotch shell-mounds so poor. The difference may perhaps in part be accounted for by the absence of flint in the North of Scotland. In Denmark, on the other hand, it is so plentiful that if an axe was broken, the pieces would often be thrown away, while in a flintless country they would in all probability have been worked up again. Still it must be remembered that in many of the Swiss Lake habitations, the flint must have been brought from a distance, and, under any circumstances, if flint implements had been much used by these Scotch mound makers we ought to find fragments and chips still; but though I looked carefully, I found nothing of the kind. How far this fact is an evidence that the Shell-mounds of the Moray Frith belong in a great measure to the metallic period, farther researches will show. In the mean time, it is an interesting fact, that a bronze pin which I shall presently describe, was found at this spot and apparently in the shell-mound itself, while on one of those between Burghead and Findhorn, we found a small fragment of bronze, apparently a bit of a ring.

But if the absence of stone implements is explicable on the assumption that these shell-mounds belong to the metallic period, the rarity of pottery is thereby rendered still more remarkable. I say the rarity, because, though neither Dr. Gordon nor I in our visits to this spot have been so fortunate as to find any, Dr. Taylor, of Elgin, obtained two small pieces, which are now in the Museum at that place. They are red on the outside, black within, and of rude manufacture, containing large grains, apparently of quartz.



The bronze pin, Fig. II., to which I have just alluded, was found by a labourer, who was employed in carting away some of the shell-mound to serve as manure for the neighbouring farm. It is four inches and a-half in length, and rather thick in proportion. The head is small and rounded, but with flat sides, which are marked by two irregular grooves, at right angles to one another, so as to form a kind of rude cross. Immediately below the head is a second small enlargement. Below this again are four equidistant rows of five small notches, one row on each side of the pin.

I do not know of any bronze pin exactly like this one from Brigzes; those from the Swiss Lake-habitations, though often flattened, are generally compressed vertically, and not laterally. Without, however, exactly agreeing with any one which I have seen, it bears a close general resemblance to some of those found in Irish crannoges, and street-cuttings in Dublin. These are generally considered to be about a thousand years old, and on submitting the Brigzes specimen to Mr. Franks, he has favoured me with the opinion that it certainly belongs to our era, and was in use probably about A.D. 800 or 900.

If, therefore, it really belong to the shell-mound, and there seems no reason to doubt the statement of the man who found it, we shall in this way, by the character of the pin on the one hand, and the study of the old maps on the other, get an approximate date for the accumulation of the mound.

It is of course evident that the presence of bronze establishes a great distinction between this shell-mound and the much more ancient kjökkenmöddings of Denmark.

There are three other small shell-mounds in the wood of Brigzes, but time did not permit us to examine these with care.

I also visited a shell-heap near the Ferry at Nigg, opposite Cromarty. It is several feet above the sea, and from it the ground slopes steeply upwards. The shells are covered by from two to four feet of sand and stones, which have no doubt found their way down from the hill above. Periwinkles at this spot formed nine-tenths of the mass, and oysters were next in point of numbers. I noticed also Buccinum, Patella, Purpura, Cardium, Mytilus, Tapes, and Solen, besides a few fragments of bone, and the tooth of an ox. Dr. Gordon also found on a previous occasion a small bone comb. In Dr. Wilde's excellent Catalogue of the Museum belonging to the Royal Irish Academy at Dublin, the combs are "divided into three varieties —the long rack-comb, the single fine tooth-comb, and the double fine tooth-comb." Dr. Gordon's is a double fine tooth-comb, or rather, it is the end of one. It is entirely free from ornament, and has lost part of its animal matter, so that it adheres slightly to the tongue. No other implements or works of art of any kind have as yet been found at this spot.

Finally I visited, but had not time to examine thoroughly, another shell-mound on the north side of the Moray Frith, near Invergordon, in a wood belonging to Mr. M'Leod, of Invergordon Castle.

That the shell-mounds of Scotland did not altogether escape the notice of Hugh Miller will be seen from the following extract, with which I have been favoured by Dr. Gordon, from the Sketch-Book of Popular Geology:—

> " The sand dunes of the country—accumulations of sand heaped over the soil by the winds, and in some cases, as in the neighbourhood of Stromness in Orkney, and near New Quay on the Coast of Cornwall, consolidated into a kind of open-grained sandstone—contain, like the mosses of the country, ancient human remains and works of art. There have been detected among the older sand dunes of Moray, broken and partially finished arrow-heads of flint, with splintered masses of the material out of which they had been fashioned—the *débris*, apparently, of the workshop of some weapon maker of the stone period. Among a tract of sand dunes on the shores of the Cromarty Frith, immediately under the Northern Sutor, in a hillock of blown sand, which was laid open about eighty years ago, by the winds of a stormy winter, there was found a pile of the bones of various animals of the chase, and the horns of deer, mixed with the shells of molluscs of the edible species; and, judging from the remains of an ancient hill-fort in the neighbourhood, and from the circumstance that under an adjacent dune, rude sepulchral urns were disinterred many years after, I have concluded that the hunters, by whom they had been accumulated, could not have flourished later than at least the age of Bronze." *

The above extract is interesting as showing that these shell-mounds had not escaped the notice of the author of the " Testimony of the Rocks," but the minute researches of the Danish and Swiss Archæologists have invested them with a new and unexpected interest, and we may fairly hope that when they shall have been thoroughly examined, they will throw much light on the early history of our country.

To do for Scotland, however, what Steenstrup has done for Denmark, will require Steenstrup's perseverance and abilities. It may be said that it would have been better to wait until the subject could be more thoroughly discussed, but my hope in publishing these few notes is to direct attention to these ancient shell-mounds, which will in all probability be found scattered along our western and northern shores. Those who may be disposed to assist in this line of research, will probably find that the shell-heaps are in many cases well known to the fishermen and peasants; on the Moray Firth, I was struck to find one of them actually going by the name of the " Shellymidding."

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* The discovery of the Bronze Pin at Brigzes seems at first sight a remarkable confirmation of the suggestion thus thrown out by the author of the " Testimony of the Rocks," but we must remember that bronze seems to have been used for articles of this description, long after the discovery of iron.

XLVI.—AN ACCOUNT OF THE PROCEEDINGS OF THE LATE CONFERENCE HELD IN FRANCE TO INQUIRE INTO THE CIRCUMSTANCES ATTENDING THE ASSERTED DISCOVERY OF A HUMAN JAW IN THE GRAVEL AT MOULIN-QUIGNON, NEAR ABBEVILLE; INCLUDING THE *Procès Verbaux* OF THE SITTINGS OF THE CONFERENCE, WITH NOTES THEREON. By H. Falconer, M.D., F.R.S.; George Busk, Esq., F.R.S.,; and W. B. Carpenter, M.D., Vice President Royal Soc.

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1. INTRODUCTORY REMARKS AND HISTORICAL SUMMARY.

THE 'Trial of the Jaw' or the inquisition by a conference of men of science, French and English, held at Paris and Abbeville, on the "human jaw" and flint *hâches*, asserted to have been discovered *in situ*, by M. Boucher de Perthes, in the '*couche noire*' of the gravel-pit of Moulin-Quignon, has excited lively general interest on both sides of the Channel. The present communication is mainly intended for the publication, textually, of the *procès verbaux* of the meetings of the Conference, and of the conclusions at which it arrived. The minutes of the proceedings, embodying a condensed abstract of the discussions, were, in the absence of a shorthand-writer, drawn up, during the progress of each *séance*, by the able and distinguished Secretary, M. Delesse, Professor of Geology to the École Normale, Paris. The debates were frequently discursive, in consequence of the variety of points involved in the investigation. The main subject was at times dropt, and questions raised on subordinate issues which, in the end, proved unimportant. M. Delesse, in the opinion of the English members of the Conference, is entitled to the highest credit for the ability, judgment, and impartiality, which he has displayed in seizing upon the leading features of the debates, and in conveying the opinions of the different speakers, under very considerable difficulties, he himself having taken an active share in the general discussion. The English members have to indicate some corrections, but, for the most part, these are not of very material importance, and it has been considered best to reproduce the '*procès verbaux*' *verbatim* in the form in which an authenticated copy has been forwarded to London by M. Delesse, pointing out the corrections in the running commentary of explanatory notes appended to the proceedings.*

It may be useful, before the production of the '*procès verbaux*,' to give a brief *resumé* of the circumstances which led to the meeting of the Conference.—Fashioned flint-weapons, unquestionably of very remote antiquity and as certain proofs of human agency as the watch in the illustration of Paley, have turned up in surprising abundance in the old gravel-beds of Amiens and Abbeville, but hitherto not a vestige of the bones of the men who shaped them into form. Why it should be so has remained a mystery, for human bones are as enduring as those of deer, horse, sheep, or oxen, and fossil bones of extinct animals are not unfrequent in the Somme Valley deposits. At last it was thought that the objects so long sought for in vain had been discovered. To pass over minor incidents. On the 23rd of March, a *terrassier* brought to M. de Perthes, from the bottom of the gravel-pit of Moulin-Quignon, two flint *hâches* and a fragment of bone, which, on detaching the dark matrix enveloping it, he found to be a human tooth. On the 28th of March, M. de Perthes was summoned to the same gravel-pit (described by Mr. Prestwich in his memoir in the *Philosophical Transactions*) to examine, *in situ*, what appeared to be a portion of bone projecting from the section, close to its base. The specimen was carefully detached with his own hands by M. de Perthes, and proved to be the entire half of an adult human lower jaw, quite perfect, and containing one back tooth—namely, the penultimate, or last but one. The sockets of the other teeth were all present, and filled with matrix, with the exception of the antepenultimate, the socket of which was effaced, the tooth having been lost during life. The solitary molar present was hollow from *caries*, and this hollow was also filled with the matrix.

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* It is further due to M Delesse to state that on the existence of these slight differences being brought to his notice by Dr. Carpenter and Mr. Prestwich, he at once expressed his readiness to make the corrections indicated; but it was considered inexpedient to alter the formal documents after signature.

The deposit from which the jaw was extracted is the "black seam flinty gravel," so called from its intensely dark (blueish-black) colour, arising from oxides of iron and manganese. It rests immediately upon the chalk, and belongs to what Mr. Prestwich calls the "high level" series, being the oldest of the Somme Valley beds. A thin layer of black mangano-ferruginous clayey matter is interposed between the chalk and the gravel. If the jaw proved to be an authentic fossil, and came out of the alleged position, it indicated the existence of man, by an actual bone, at a period of extremely remote antiquity. A single detached human molar was found at the same time, corresponding exactly in appearance and in the matrix with which it was covered; and, to complete the case, a flint hatchet, covered with black matrix, was extracted from the same spot by M. Oswald Dimpre, who accompanied M. de Perthes. The details are all given by M. de Perthes in the *Abbevillois* of the 9th of April, 1863, and in his note communicated to the Academy of Sciences on the 20th of April which is here subjoined.

Mr. Prestwich, Mr. Evans, and Dr. Falconer were in France at the time, and hearing of the asserted discovery, they determined to visit Abbeville. The two former proceeded there on the 13th of April, when their suspicions were instantly aroused. They pronounced the *hâches* said to have been yielded by the '*couche noire*,' to be modern fabrications. Dr. Falconer followed a day later, when they had left, and also got several *hâches* from the "black-seam gravel," which, upon closely examining them on his return to London, he considered to be spurious. Having been obligingly permitted by M. de Perthes to examine the jaw, he was struck with the unusual combination of peculiar anatomical characters which it presented, and was thus led to the impression that it was of fossil antiquity. That impression he communicated on the 14th to Dr. Carpenter, and on the 15th to M. de Quatrefages, at Abbeville, but subject to the reserve of a more detailed study of the materials,* and on the 15th he wrote to the same effect to his friend, M. Lartet, to whom the jaw was consigned in Paris.

On the 16th of April Dr. Carpenter communicated a short paper to the Royal Society, supporting the authenticity of the discovery; and during the debate, Dr. Falconer, in the absence of Dr. Carpenter and himself, was unauthorisedly cited as entertaining the same opinion. On the 20th of April M. de Quatrefages communicated to the 'Academy of Sciences' a note by M. Boucher de Perthes, followed by descriptive remarks by himself, conveying the high authority of his opinion in favour of the jaw being a true fossil of geological antiquity. On the 18th of April, Dr. Falconer, immediately after his return to London, commenced the deliberate scrutiny of the materials which he had brought with him from Abbeville, and on the 21st, in conjunction with, or aided by, Mr. John Evans, Mr. Prestwich, Mr. Busk and Mr. Tomes, he arrived at results opposed to the authenticity alike of the 'detached molar,' of the jaw, and of the flint *hâches.* That day, without the delay of a post, he communicated his suspicions to M. Lartet, requesting him to make them, and the grounds upon which they were founded, known to M. de Quatrefages. But the latter had already given in his affirmative memoir to the "Institut" on the previous day (20th), followed on the 27th of April and 4th May by successive notes in the same sense. On the 25th of April a letter by Dr. Falconer, written before he was aware of M. de Quatrefage's first communication appeared in the *Times*, questioning the authenticity of the "jaw" and of the *hâches.* Men of science in France and England were thus suddenly placed at direct issue on a grave and important point of great general interest. But, happily, from the frankness and rapidity of the communications interchanged, there existed the most cordial relations, and the conviction of loyalty and good faith on both sides. The French *savans* the more they went into the case, were the more convinced of the soundness of their conclusions; while their English opponents, the more they weighed the evidence before them were the more strengthened in their doubts. As a wordy discussion would but have wasted time and must have been protracted, and as a personal conference held out the best prospect of a speedy settlement of the question, a '*réunion*' of men of science, to be held at Paris, was proposed by the French *savans.*

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* The reserve is expressly mentioned by M. de Quatrefages in the first paragraph of his note read to the Academy of Sciences on the 20th of April, 1863:—"Néanmoins nous nous sommes quittés avec l'intention de faire subir aux objets eux-memes un examen ultérieur."—(Vide *Comptes Rendus* du 20 Avril.)

On the 4th of May Dr. Falconer received a letter from his friend M. Lartet, who was in constant communication with M. de Quatrefages, dated the 2nd of May, in which, after recapitulating the points at issue, he added: —

"La dissidence ainsi posée, le mieux serait de se réunir pour procéder à de nouvelles verifications des pièces controversées, et pour discuter la valeur de toutes les circonstances qui se rattachent à cette découverte. Le lieu le plus convenable pour cette réunion, serait, ce me semble, Paris, puisque nous y sommes présentement en possession de la mâchoire et du plus grand nombre des *hâches* trouvées a Moulin-Quignon. Nous aurions aussi, le cas écheant, toutes les facilités desirables pour faire procéder à des analyses, ou autres verifications que l'on pourrait juger necessaires."

The note then suggested that Messrs. Prestwich and Evans should be members of the proposed réunion. On the following day Dr. Carpenter called upon Dr. Falconer with the following note, which he had received from M. de Quatrefages:—

"Monsieur et cher Confrère. Je viens vous faire une proposition, quelque peu étrange peut-être mais, vous voudrez bien, j'en suis sûr, la prendre dans le sens qui me pousse à vous l'addresser. Voici ce dont il s'agit.

"M. Lartet vient de me dire qu'il a écrit à M. Falconer pour l'engager à venir à Paris avec MM. Prestwich et Evans pour soumettre à un nouvel examen les hâches et la fameuse mâchoire de Moulin-Quignon.

"Or d'après les renseignements que j'ai reçus, vous étes vous même fort intéressé dans la question; car le premier vous avez parlé de la machoire d' Abbeville devant un corps savant et dans le sens de l'authenticité.

"Cette authenticité me semble de plus en plus certaine. Toutes les épreuves aux quelles j'ai soumis *mes* hâches et la mâchoire, soit d'après mes inspirations propres, soit à la demande de M. Delesse, sont venues corroborer cette conclusion. M. Delesse et venu faire un second examen depuis la lecture de sa lettre à l'Académie; il est parti de plus en plus convaincu de l'authenticité des unes et de l'autre. M. Desnoyers, M. Gaudry n'ont pas mis un instant en doute cette authenticité après un examen sérieux.

"Eh bien Monsieur et cher Confrère, si MM. Falconer, Prestwich, et Evans viennent à Paris, ne pourriez vous faire le voyage avec eux? Je tiendrais beaucoup à ce que cette réunion n'eut pas l'air d'une lutte où les partis seraient pris d'avance, les Francais combattant *pour* et les Anglais *contre*. Or quoique nous soyons tous animés d'un même amour de la vérité, et de la *seule vérité scientifique*, le fait semble établir cette distinction entre les naturalistes des deux nations. Votre présence ôterait tout de suite à la réunion ce caractère facheux et, pour mon compte j'aurais à vous revoir dans cette circonstance une double joie.

"Soyez assez bon pour réfléchir à ce que ma proposition a au fond d'intérêt pour la science, et recevez l'expression des sentiments d'estime et de la consideration de votre devoué confrère.

(Signed) A. DE QUATREFAGES.

"2 Mai, 1863."

Dr. Falconer replied to M. Lartet, and Dr. Carpenter to M. de Quatrefages, that they would start for Paris on the 8th of May. On the 6th of May Dr. Falconer wrote to M. Lartet that as neither Mr. Prestwich nor Mr. Evans could go on account of business engagements, Prof. Busk would probably accompany Dr. Carpenter and himself—forwarding at the same time a rough memorandum for adoption as the basis of the procedure during the inquiry by the proposed Conference, which ran as follows:—

"*Proposed Order of Procedure.*

"1. To go into the evidence of the mineral characters of the '*couche noire*' and flint gravel of Moulin-Quignon.
"2. The evidence of the *hâches contrefaites et indubitables* de Moulin-Quignon.
"3. The evidence of the detached molar.
"4. The evidence of the human jaw of Moulin-Quignon; (*a*) mineral characters of the matrix; (*b*) transverse section; (*c*) *caractères de race.*
"5. To go into the evidence of the Menchecourt fragment of lower jaw and teeth.
"6. To draw up a '*procès verbal*' of the séance and final results.

"London, 6th of May, 1863."

It was understood, when the English members of the Conference arrived in Paris, that this scheme was adopted; but it was not pressed, nor was it strictly followed in the subsequent proceedings. The clause (*c*) of No. 4, and the details of No. 5, were not gone into at all. The excursion to Abbeville was not contemplated in the scheme.

The English deputation, consisting then of Dr. Falconer, Dr. Carpenter, and Prof. Busk, reached Paris on the 9th of May, and immediately proceeded to business, being joined on the following day by Mr. Prestwich. The French members consisted of M. de Quatrefages, Member of the Institut; M. Lartet, Member of the Geological Society of France and Foreign Member of the Geological Society of London; M. Delesse, Professor of Geology to the École Normale, Paris; and M. Desnoyers, Member of the Institut. The following *savans* also took a share in the proceedings throughout, and afforded the utmost aid in the investigation, viz.:—M. L'Abbé Bourgeois, M. A. Gaudry, and M. Alphonse Milne-Edwards. At the request of the English members, M. Milne-Edwards, Member of the Institut, and the eminent zoologist, courteously agreed to preside over the Conference.

In order to render this account of the circumstances which led to the assembling of the Conference in Paris complete, and to place our readers in full possession of the facts connected with the discovery of the 'jaw,' we here subjoin the account given by M. Boucher de Perthes, in his note on the subject communicated to the Academy of Sciences, which follows *in extenso*:—

Extrait des *Comptes rendus des Séances de l'Académie des Sciences.* Tome lvi. Séance du 20 Avril, 1863—

Mâchoire humaine découverte à Abbeville dans un terrain non remanié; Note de M. Boucher de Perthes.

(Présenté par M. de Quatrefages.)

"Une longue expérience m'ayant appris qu'une des causes qui empêchent le naturaliste de recueillir des ossements humains dans les terrains qu'il explore est l'habitude qu'ont les terrassiers de faire disparaître ces débris, j'avais depuis quelques années offert une assez forte prime à ceux qui m'en apporteraient, m'engageant à doubler la récompense s'ils me faisaient voir ces restes sans les déplacer ou dans le lieu même où ils les auraient découverts.

"Dès ce moment il m'en fut beaucoup présenté. On m'en signala d'autres que j'allai reconnaître sur les lieux. Dans ces ossements il y en avait de fort anciens, quelques-uns de curieux, mais pas un seul qui fût fossile.

"Vers la fin de 1861, en faisant fouiller dans la sablière de Moulin-Quignon, banc situé près d'Abbeville, à 30 mètres au-dessus du niveau de la Somme, je remarquai à 4 et 5 mètres au-dessous du sol un lit de sable brun tranchant trés-fort sur les couches supérieures de sable jaune ou gris et reposant sur la craie.

"Cette veine argilo-ferrugineuse, presque noire, imprégnée d'une matière colorante s'attachant aux doigts, et qui doit contenir des matières organiques, varie de 30 à 60 centimètres d'épaisseur; elle ne se confond pas avec les bancs supérieurs, et suit toutes les ondulations de la craie sur laquelle elle repose à une profondeur de 4 à 5 mètres de la superficie.

"Pendant l'année 1862 et les premiers mois de 1863 la carrière de Moulin-Quignon etant restée ouverte, je pus y etudier cette couche et j'y trouvai plusieurs silex taillés en hachettes, les unes fort grossières et différant, par la couleur et par leur coupe, de celles des bancs supérieurs; les autres beaucoup mieux faites, rarement roulées et peu endommagées, ce que j'attribuai à la nature du lit moins caillouteux que ceux du dessus.

"L'état de conservation de ces hâches, dû à l'absence de gros

silex dans cette couche, et, comme je viens de le dire, une certaine apparence de matières organiques, me firent espérer d'y trouver des ossements ou des coquilles. Je le dis aux terrassiers, en leur renouvelant ma prescription de laisser en place ce qu'ils pourraient découvrir.

"Le 23 mars, l'un de ces terrassiers, Nicolas Halattre, m'apporta dans une masse de sable deux hâches en silex trouvées à 4^{m}, 50 de profondeur. A 15 centimètres plus bas, près de la craie, était, dans ce même sable, un fragment d'os, ou ce qu'il prenait pour tel, mais qu'après avoir dégagé de sa gangue je reconnus pour une dent humaine.

"Une demi-heure après j'étais à Moulin-Quignon: je vis la place d'où les deux hachettes et la dent avaient été extraites, et l'exposé de Halattre me fut confirmé par les autres terrassiers.

"De la découverte de cette dent j'ai dû conclure que la mâchoire était proche; je fis ouvrir le terrain, j'y trouvai une troisième hachette, mais la nuit vint interrompre mes recherches.

"Les jours suivants, les terrassiers étant occupés ailleurs, les travaux furent interrompus.

"Le 26, je chargeai deux autres ouvriers, Dingeon et Vasseur, de continuer la fouille.

"Le 28, Vasseur se présenta chez moi: il m'apportait une seconde dent, trouvée non loin de l'endroit où avait été découverte la première, ajoutant qu'à côté était un os, ou quelque chose qui y ressemblait, dont on ne voyait qu'une petite partie. Je me rendis immédiatement à la carrière, en me faisant accompagner d'un archéologue de notre ville, M. Oswald Dimpre, habile dessinateur, bien connu des géologues qui ont visité nos bancs.

"Arrivé sur le banc, après avoir retrouvé l'excavation telle que je l'avais laissée à 5 mètres au-dessous du sol, j'aperçus, dans la couche noire, le bout de l'os que m'avait signalé Vasseur. Ce terrain était fort compacte, il fallait user de précaution pour ne rien endommager. Je fis dégager les alentours de l'os, dont je voyais l'extrémité; je pus le tirer de son lit sans le rompre. et, malgré une masse de sable qui y adhérait, je reconnus la moitié d'une mâchoire humaine.

"A 20 centimètres de là, dans la même veine noire, était une hachette que M. Dimpre ne put détacher qu'après quelques efforts et avec l'aide d'une pioche.

"Près de la mâchoire je trouvai une seconde hache brisée, et, dessous, une troisième dent. Enfin, dans une masse du même sable que j'ai fait transporter chez moi, je découvris une portion d'une quatrième dent.

"Cette mâchoire humaine était au plus bas de la couche de sable noir, et à quelques centimètres de la craie.

"Voici le détail des couches qui la recouvraient, que je mesurai, et dont M. Dimpre fit le dessin:

"1° Couche terre végétale	0^{m}, 30
"2° Terrain non remanié, sable gris mêlé de silex brisés	0^{m}, 70

"3° Sable jaune, argileux, mêlé de gros silex peu roulés, s'appuyant sur une couche de sable gris . .	1^{m}, 50
"4° Sable jaune, ferrugineux; silex moins gros et plus roulès, au-dessous desquels est une couche de sable moins jaune. J'ai trouvé dans cette couche des fragments de dents de l'*Elephas primigenius* et des hachettes en silex	1^{m}, 70
"5° Sable noir, argilo-ferrugineux, colorant la main et s'y attachant, paraissant contenir des matières organiques; petits cailloux plus roulés que dans les bancs supérieurs; silex taillés de main d'homme; mâchoire fossile humaine	0^{m}, 50
	4^{m}, 70

"6° Banc de craie sur lequel repose le lit de sable argileux noir, à une profondeur de 5 mètres au-dessous de la superficie.

"C'est donc dans la cinquième couche, couche couverte par quatre autres couches superposées de sable et d'argile mêlés de silex, qu'était cette mâchoire qui m'a frappé tout d'abord par la similitude parfaite de sa teinte noire avec celle des hachettes trouvées à côté ou au-dessous, et les silex roulés ou non ouvrés au milieu desquels elle était.

"A la première vue, cette mâchoire me parut présenter certaine différence avec une mâchoire ordinaire. M. Jules Dubois, médecin de l'Hôtel-Dieu d'Abbeville, et M. Catel, chirurgien-dentiste, bon anatomiste, à qui je la montrai, firent la même remarque. M. Jules Dubois trouva que la branche ascendante était plus oblique d'arrière en avant qu'elle ne l'est chez l'homme de nos jours, et que le condyle lui même est déjeté en dedans et un peu en bas. Sa conclusion fut que cet homme devait appartenir à une autre race qu'à la nôtre.

"Son confrère le docteur Hecquet, connu, comme M. Dubois, par de bons Mémoires sur les sciences naturelles et médicales, partagea cette opinion, ajoutant que cette différence avec la forme ordinaire pouvait être une anomalie, mais qu'elle était tellement prononcée, qu'elle devait fixer sérieusement l'attention.

"Je joins ici le dessin de la mâchoire fossile et la coupe du banc de Moulin-Quignon, faite sous mes yeux par M. O. Dimpre, et d'après les mesures prises par moi-même.

"Comme la première dent trouvée est une molaire de gauche, et que je n'ai que la partie droite de la mâchoire, je suis maintenant à la recherche de l'autre moitié, et je continue les fouilles à Moulin-Quignon.

"Sous peu de jours j'expédierai à Paris, pour être mis sous les yeux de l'Académie à l'appui de ce Rapport, la mâchoire que j'ai trouvée et les autres débris que je pourrai trouver encore."

We now proceed to reproduce the text of the '*Procès verbaux:*'—

(2.)

EXAMEN DE LA MACHOIRE HUMAINE ET DES SILEX TAILLÉS TROUVÉS à MOULIN-QUIGNON. PROCÉS. VERBAL DE LA SÉANCE DU 9 MAI, 1863.

Le 9 Mai, 1863, à midi MM. Falconer, Carpenter, Busk, De Quatrefages, Desnoyers, Lartet et Delesse, se sont réunis dans le laboratoire de Géologie du Muséum et ont prié M. Milne Edwards de prendre la présidence.

M. Delesse a été chargé des fonctions de secrétaire.

MM. l'Abbé Bourgeois, Buteux, Gaudry et Alphonse Milne Edwards ont assisté à la séance et ont pris part aux discussions à titre de témoins.

M. le Président ouvre la séance et observe qu'avant d'aborder la question de fond, il importe d'ouvrir la discussion sur les caractéres qui sont attribuées aux *hâches* considerées comme *authentiques* et à celles qui sont considerées comme *fausses.*

Il donne à ce sujet la parole à M. le Docteur Falconer.

M. Falconer commence par établir les caractères que doivent présenter, d'après lui, les hâches authentiques :

1°. Elles ont été taillés avec des pierres et par consequent elles ne portent pas des empreintes metalliques.

2°. Leurs facettes sont plus applaties, moins profondes et moins conchoides que dans les hâches fausses. Ce fait est attribué par M. Falconer à une cause physique.

3°. Elles ont ordinairement un certain brillant et un poli qui est comme satiné.

4°. Elles sont souvent recouvertes par de la patine ou par des incrustations et l'on y observe aussi des dendrites.

5°. Elles n'ont pas les petites esquilles qui se montrent habituellement dans la cassure fraîche du silex. (1.)

6°. Elles sont presque toujours usèes sur les bords.

La gangue est simplement étaleé sur les hâches fausses en sorte qu' on peut l'enlever très facilement par le lavage et alors on peut reconnaître que leur surface est récente.

Dans la gangue qui enveloppe les hâches du Moulin-Quignon on voit quelquefois des debris végétaux.

M. Falconer fait ensuite laver une hâche du Moulin-Quignon trouvée par M. A. Brady pendant que les ouvriers faisaient leur repas et qui a été envoyée par M. Boucher de Perthes. Il montre que cette hâche perd par le lavage la gangue qui la recouvre. M. Falconer ajoute encore qu'on a constaté une fabrication frauduleuse de hâches en silex à Moulin-Quignon et que dans ces derniers mois notamment, cette fabrication a beaucoup augmenté. (2.)

M. de Quatrefages observe d'une manière générale que certains caractères donnés par M. Falconer lui semblent très bons, mais que d'autres lui paraissent moins acceptables.

M. le Président dit qu'il est nécessaire maintenant d'ouvrir la discussion sur chacun des points qui ont été successivement traités par M. Falconer; par suite il convient de s'occuper en premier lieu des hâches authentiques.

1°. D'abord tout le monde admet que les hâches authentiques en silex ont été taillées seulement par de la pierre, si donc on trouve des traces de fer sur une hâche en silex ou peut craindre qu'elle soit frauduleuse et de fabrication moderne.

2°. MM. de Quatrefages et Desnoyers observent que des hâches incontestablement authentiques sont souvent trés inégales dans leur cassure ; elles ont des surfaces conchoides et très concaves. De plus M. de Quatrefages ajoute que cela dépend essentiellement du coup de main de l'ouvrier et de la nature du silex. De sorte que pour obtenir constamment les mêmes formes, il faudrait qu' il y eût eu toujours le même ouvrier et le même silex. Il remarque que dans une même hâche, considerée comme authentique par M. Falconer, et provenant de St. Acheul il y a toutes les varietés de taille. Les hâches apportées par MM. Desnoyers et Gaudry prises sur les lieux par eux, présentent aussi le même caractère.

M. L'Abbé Bourgeois observe que suivant que les ouvriers fabriquent la pierre à fusil emploient un marteau gros ou petit, ils obtiennent des cassures inégalement profondes.

M. Lartet ajoute que très souvent la forme des cassures varie suivant le type de la hâche ; dans les hâches allongées les facettes de taille sont généralement plus larges et plus étendues.

3°. M. Gaudry objecte au 3° point developpé par M. Falconer que des échantillons trouvés dans la même couche présentent des caractères très differents en ce qui concerne leur aspect de surface. Des variations de cette nature s'observent dans des échantillons trouvés à côté l'un de l'autre.

MM. Bourgeois et Lartet pensent que ces différences peuvent tenir à l'èpòque de l'enfouissement, à ce que les hâches n'ont pas été taillées ensemble et à ce qu'elles sont restées plus ou moins longtemps exposées à l'air.

M. Desnoyers insiste sur cette considération; elle est très importante, car elle explique les différences et les particularités que présentent à cet égard les diverses hâches d'un même gisement.

M. de Quatrefages dit que le poli ou le luisant des hâches depend du frottement qu' elles ont subi. Il ajoute qu'on trouverait dans une cassure fraîche de la hâche un contrôle très precieux.

M. Busk pense que si les hâches [arêtes, G. B.] sont arrondies cela tient surtout à une action de dissolution exercée par les eaux d'infiltration. M. Desnoyers dit cependant qu' elles ont quelquefois été roulées et qu'alors c'est le résultat d'une action mécanique. M. Busk ajoute que les cassures profondes se montrent rarement sur les hâches vraies.

4°. Tout le monde est d'accord sur le quatrième point.

M. de Quatrefages dit cependant que l'absence de dendrites ou d'incrustations ne prouve pas que les hâches ne soient pas authentiques. Tous les membres de la commission reconnaîssent l'exactitude de l'observation de M. de Quatrefages.

5°. M. de Quatrefages remarque que les esquilles minces considerées par M. Falconer comme un indice des hâches fausses s'observent quelquefois, bien que plus rarement, sur les cailloux roulés eux mêmes. MM. Falconer et Busk pensent que l'existence de ces esquilles sur des cailloux roulés peut dépendre de fractures posterieures à leur extraction. MM. Desnoyers et Delesse disent que ces esquilles se montrent aussi sur des hâches authentiques et par conséquent elles ne donnent pas un caractère d'exclusion suffisant.

M. Gaudry observe que ces esquilles sont fréquentes notamment dans les hâches de St. Acheul ; elles ont pû tomber on le conçoit par l'usage ou dans les echantillons roulés.

M. l'Abbé Bourgeois a observé des marteaux remontant au moins à l'époque celtique qui présentent encore ces esquilles.

6°. M. de Quatrefages dit que les hâches n'ayant pas servi peuvent très bien avoir été trouvées et alors on conçoit qu' elles n'ont pas dû être usées sur leurs bords. MM. Desnoyers et Bourgeois remarquent, qu'à St. Acheul notamment, il parait y avoir eu des fabriques anciennes de hâches qui auraient été abandonnées sur place et sans avoir servi.

La différence entre les hâches roulées et celles qui ne le sont pas, tient à leur gisement ; les premières sont dans le gravier et les secondes dans le sable qui repose sur la surface de la craie. Ces faits s'observent à Moulin-Quignon et à St. Acheul.

M. Falconer revenant sur le cinquième point dit qu'il ne pense pas que dans un lit de gravier comme celui de Moulin-Quignon, l'on puisse trouver une hâche veritablement authentique et incontestable ayant les esquilles très minces qu'il a indiquées. (3.)

En ce qui concerne les hâches fausses, M. de Quatrefages admet bien leur existence ; mais les caractères indiqués par M. Falconer ne sont pas suffisants pour démontrer qu'une hâche n'est pas authentique ; autrement on serait conduit à considérer seulement comme authentiques les hâches qui auraient été exposées à l'air, vieillies par l'usage ou bien roulées.

M. Desnoyers se joint à M. de Quatrefages. M. de Quatrefages ajoute que toute hâche ensevelie peu de temps après sa fabrication et dans le voisinage des fabriques se trouverait par cela même exclue ; et cependant tout tient à prouver qu'il y en a qui ont été enfouies dans ces conditions. En Danemark, on a trouvé des instruments en pierre à arêtes très vives provenant des amas ossifères.

M. de Quatrefages observe que la trace de coups de marteaux peut très bien provenir de coups de pic donnès par l'ouvrier au moment où il opère le déblai.

M. Lartet pense que des hâches authentiques peuvent très bien présenter des traces de coups perpendiculaires à leur surface applatie. (4.)

M. de Quatrefages relativement à la gangue des hâches fausses observe que l'argile s'enlevera plus facilement que du sable mais sans laisser de traces; les cailloux pris dans le même gisement présentent les mêmes facilités de lavage. Qu'on lave des cailloux pris au même lieu et on aura des surfaces parfaitement blanches et nettes même sur du silex provenant de la couche noire de Moulin-Quignon.

Relativement aux debris de végétaux qui se trouvent dans le gangue adhérent aux hâches, M. de Quatrefages dit qu'il faudrait voir si on n'a pas des debris semblables dans le terrain qui contient les hâches. Que d'ailleurs on sait que les racines des plantes peuvent pénétrer à de très grandes profondeurs dans le sol et que par conséquent les debris de plantes pourraient venir soit de l'époque actuelle soit d'une époque antérieure. Il resterait encore à examiner si ces debris proviennent encore de plantes cultivées actuellement dans la localité.

M. l'Abbé Bourgeois fait voir que dans la gangue présentée par M. Falconer il y a des debris végétaux analogues et notamment ce qu'il croit être une fibrille de racine qui sera ultérieurement examinée au microscope. Après avoir fait cet examen M. Carpenter a découvert des fibres végétales et un poil decoloré de rongeur ou de chauve-souris. (5.) L'échantillon de gangue qui renfermait de débris provenait de la partie inférieure de la couche du terrain de transport, et portait encore des fragments de la craie sur laquelle il reposait.

M. le Président fait apporter un tiroir de hâches recueillies à St. Acheul par M. A. Gaudry et il prie M. Falconer d'indiquer qu' elles sont celles qui lui paraissent vraies ou fausses. M. Busk de son côté procède à la même opération sans avoir connaissance du travail fait par M. Falconer. M. Busk déclare qu'une des hâches seulement sur 22 qui lui sont présentées lui parait être douteuse, c'est le No. 19; quant à M. le Dr. Falconer il en suspecte sept, les Nos. 14, 15, 16, 18, 20, 21, mais il n'affirme cependant pas qu'elles soient fausses.

MM. Falconer et Busk examinent ensuite une autre série de 21 échantillons recueillis à St. Acheul par M. Desnoyers et ils les considérent comme authentiques à l'exception de 2 ou 3 qui leur laissent quelques doutes.

M. le Président observe que parmi les échantillons considérés comme incontestablement authentiques par ces deux messieurs, M. Busk en a signalé un qui présente à la fois des dendrites et les esquilles très minces considérées comme caractèristiques des hâches fausses.

M. Busk ajoute cependant que ces esquilles pourraient être distinguées de celles qui sont sur les échantillons récents parce qu'elles sont legèrement colorées par suite de l'interposition d' un petit filet de gangue. Elles sont d'ailleurs moins nombreuses et plus petites par suite de la cassure de leurs bords.

M. de Quatrefages remarque qu'elles ne sont pas toutes colorées et qu'elles ne différent pas, à son avis, de celles qu'on voit sur certains echantillons recemment taillés.

Parmi les échantillons recueillis à St. Acheul par M. Gaudry il s'en trouve quatre de ceux considerés comme bien authentiques, qui ont encore des esquilles très evidentes. M. Falconer pense que ces esquilles n'ont pas les caractères que l'on observe sur les échantillons récents.

M. l'Abbé Bourgeois présente un échantillon taillé depuis quelques jours sur lequel ou reconnait très bien des esquilles semblables à celles des hâches authentiques.

Parmi ces mêmes échantillons M. Desnoyers en signale plusieurs dont les facettes présentent une cavité toute aussi profonde que dans les échantillons de fabrication récente.

MM. Busk et Falconer reconnaissent la vérité de cette observation, mais ajoutent que dans les hâches authentiques ces cavités profondes sont exceptionnelles; tandis qu'elles sont constantes dans les hâches fausses.

M. de Quatrefages rappelle d'ailleurs que cette particularité dépend du coup de main et de la nature du silex. On reconnait comme le remarque M. Desnoyers des types différents dans des localités différentes.

M. Carpenter donne lecture d'une lettre par laquelle M. Prestwich expose les motifs par lesquels il conteste l'authenticité des hâches de Moulin-Quignon: voici quels sont ces motifs:

1°. Les hâches de Moulin-Quignon ont des arêtes trop vives.

2°. Leur gangue se détache trop facilement.

3°. On n'observe pas de dendrites sur leur surface.

4°. Elles ont été trouvées en nombre considérable.

5°. Sur certains échantillons, il semblerait que la matière argileuse a été étendue avec une brosse.

6o. Toutefois d'autres echantillons se rapprochent tellement des formes authentiques qu'il n'est pás possible de les en distinguer.

7°. D'après cela M. Prestwich pense qu'il est nécessaire de mettre de la reserve dans son jugement, et de s'eclairer en faisant une analyse de la mâchoire. (*5a.*)

Ces objections de M. Prestwich seront examinées ultérieurement.

Ensuite il est donné également lecture d'une lettre du Docteur Ch. Murchison qui annonce avoir observé avec MM. Falconer, Brady père et Brady fils des traces de fer sur un des échantillons rapportés par M. Brady et portant la marque du contact d'un instrument en fer. (6).

M. Carpenter déclare avoir également constaté au microscope l'existence de particules de fer sur ce même échantillon.

M. Desnoyers fait observer que la pioche de l'ouvrier pouvait avoir occasionné cet accident et que si les hâches reputées fausses avaient été fabriquées à l'aide d'instruments en fer, ou pourrait trouver sur toutes ou presque toutes des traces analogues; et cependant cet indice n'a été rencontré que sur un seul échantillon et il est tellement faible que sachant que cet échantillon se trouve sur la table parmi quelques autres M. Falconer n'ont pas pu le reconnaître pour le montrer à la commission.

La séance est levée à 6½.

Séance du 10 *Mai*, 1863.—*Prèsidence de Mr. Milne Edwards.*

Sont présents: MM. Falconer, Busk, Carpenter, Prestwich. (7.) De Quatrefages, Desnoyers, Lartet, L'Abbé Bourgeois, Gaudry, Alphonse Milne Edwards, Delesse.

M. Delesse remplit les fonctions de secrétaire.

La séance est ouverte à 11 heures dans le laboratoire de géologie du Muséum. Le procès verbal de la séance précedente est lu et approuvé.

M. de Quatrefages demande la parole à l'occasion du procès verbal. Il désire que M. Falconer reproduise la hâche de Moulin-Quignon qui a été lavée hier; car màlgré l'emploi de l'eau chaude et du savon il y reste encore de la gangue. De plus elle conserve une teinte marquée sur des points où l'on ne voit pas de pores. Elle porte le No. 1 dans la collection apportée par M. Falconer et elle a été trouvé en place par M. Nicolas Brady, le 17 Avril, 1863. C'est d'ailleurs une des hâches que MM. Falconer et Busk déclarent fausses.

M. Busk dit que dans l'endroit où il n'y a pas de rugosité la gangue n'adhère plus à cette hâche.

Une cassure est alors faite par M. de Quatrefages afin de comparer la surface fraîche avec l'ancienne. Sur la surface fraîche, on observe un grand nombre d'esquilles minces qui manquent sur l'ancienne surface. Sur cette dernière on aperçoit une teinte très marquée, en l'examinant au microscope ou reconnait que la teinte qui la recouvre est produite en partie par de petites plaques, en partie par des granulations de limonite. (8.)

M. Milne Edwards rappelle que cet echantillon a été brossé à deux reprises, à l'eau chaude et au savon, et en présence de la commission.

M. Falconer reconnait que dans l'état actuel de l'échantillon, il y a une legère différence entre la cassure fraîche et la surface originelle; mais il pense que cette différence tient seulement à ce que le lavage a été imparfait et n'a pas enlevé la totalité de la gangue appliquée artificiellement lorsquelle est encore retenue dans les anfractuosítée de la surface.

M. De Quatrefages repète qu'il tient à bien constater que quelques uns des points colorés par la gangue sont en saillie et non pas en creux.

MM. Prestwich et Busk demandent à procéder à un nouveau lavage de cet échantillon.

M. de Quatrefages observe ensuite relativement aux esquilles se montrant à la surface du silex que leur nombre tient surtout au silex que l'on taille et à la manière dont les coups de marteau sont donnés. Il présente, en effet, deux silex nouvellement taillés, dont l'un a beaucoup d'esquilles, tandis que l'autre en a incomparablement moins. De plus, parmi les esquilles qu'on voit sur les silex qui sont taillés récemment il y en a aussi qui sont cassées.

M. Falconer répond que les échantillons présentés par M. de Quatrefages ne sont pas comparables aux silex taillés anciens; parce que sur l'un des échantillons qui est un bloc, l'on a détaché seulement des éclats par un coup sec, et dans ces circonstances, il ne se produit que très peu d'esquilles, tant sur le bloc que sur le fragment détaché; tandis que pour faire une hâche les échantillons ont dû être martelés par des coups petits et repétés donnés dans des directions variés, d'où résultent des déchirures et une multitude d'esquilles qui ne disparaissent qu'à la longue. Pour que la comparaison fût probante il faudrait donc que la taille et les echantillons fussent absolument les mêmes. (9.)

M. de Quatrefages fait remarquer que tout ce que vient de dire M. Falconer s'accorde avec ce qu'il dit lui même, puisqu'il attribue la fréquence ou la rareté des esquilles à la nature du silex et à la manière dont il est travaillé.

M. Lartet présente une hâche de St. Acheul trouvée en 1861, qu'il considére comme authentique et qui montre à la fois les esquilles, la cassure concave et conchoide, ainsi que les arêtes vives que MM. Falconer et Busk considérent comme les signes caracteristiques d'une fabrication frauduleuse.

M. Prestwich examine cet échantillon et declare qu'il le considére comme faux, attendu qu'il n'y voit ni les dendrites ni les incrustations, ni la décoloration qui caractérisent les hâches authentiques. Il ajoute d'ailleurs qu'il n'attache que peu d'importance à l'existence ou à l'absence des esquilles, (10) cependant lorsque ces esquilles sont anciennes, ou voit audessous d'elles des dépôts de matière colorante qui resultent d'une infiltration capillaire produite par les eaux. Il fait observer également que l'échantillon en question porte des fragments de gangue appartenant à deux couches distinctes ce qui n'a jamais lieu dans les échantillons authentiques; cela s'expliquerait très bien au contraire par l'enfouissement d'une hâche fausse dans les terrains éboulés au pied d'un tranchée.

M. de Quatrefages remarque que la présence ou l'absence de matières colorantes sous les esquilles tient essentiellement à la nature de la couche dans laquelle se trouvent les silex taillés.

M. l'Abbé Bourgeois dit que les ouvriers déposent souvent momentanément les hâches dans une couche différente de celle dans laquelle elle se trouvent; en sorte que des débris provenant de deux couches distinctes peuvent très bien y adhérer.

M. Alphonse Milne Edwards observe que tous les échantillons au nombre de vingt, taillés recemment qui ont été apportés par M. l'Abbé Bourgeois présentent des traces bien visibles de fer métallique. Cependant un de ces échantillons a été recueilli dans des déblais qui sont abandonnés depuis près de quarante ans. Au contraire les échantillons de hâches sur lesquels la discussion est ouverte n'en ont que très accidentellement.

M. Delesse ajoute que tout coup de marteau si léger qu'il soit, donné sur un silex, laisse toujours une empreinte qui est bien visible à la loupe, et M. Alphonse Milne Edwards observe que cette empreinte ne s'enlève que trés difficilement.

M. Falconer demande à MM. Desnoyers et de Quatrefages quels sont les caractères à l'aide desquels ils reconnaissent qu'une hâche est fausse.

M. Desnoyers dit qu'en ce qui concerne les hâches, leur authenticité ne peut être revoquée en doute lorsqu'elles sont trouvées en place; c'est avant tout une question de gisement. Il indique cependant comme fausses certaines hâches qu'il présente et qui ont été vendues à M. Boucher de Perthes comme provenant des tourbières. Souvent il est possible de constater par l'inspection d'une hâche et sans avoir égard à son gisement, si elle est bien authentique; mais le contraire ne lui parait être que rarement possible, le gisement restant à ses yeux la chose capitale.

M. de Quatrefages dit qu'en effet le gisement doit toujours décider de l'authenticité des hâches. Si l'on appliquait à la rigueur les règles posées par M. Falconer pour reconnaître les hâches fausses, on arriverait à rejeter la plus grande partie de ces hâches, même celles qui ont été prises en place. En resumé il est presque impossible de déclarer qu'une hâche n'est pas authentique parceque certains caractères ne s'y trouvent pas.

M. A. Gaudry rappelle que les hâches qu'il a trouvées en place a St. Acheul ont en partie été regardées comme douteuses par M. Falconer.

M. De Quatrefages dit que si un antiquaire venait à trouver lui même un objet d'antiquité dans une fouille, il serait impossible de le revoquer comme authentique, bien que cet objet pût être parfaitement conservé. On sait assurément que les objets d'antiquité peuvent s'imiter avec une très-grande perfection; mais lorsqu'on les trouve en place, il n'est pas possible de contester leur authenticité.

M. Prestwich dit qu'il est quelquefois très difficile de reconnaître par la forme seulement si les hâches en silex sont fausses. Il ne doute pas que les ouvriers de la Picardie n'arrivent un jour à les fabriquer avec un très-grande perfection, comme cela a lieu maintenant en Angleterre pour les pointes de flèches. Cependant, les échantillons authentiques présentent habituellement certains caractères qui permettent de les reconnaître; tandis que les échantillons frauduleux offrent des particularités qui éveillent les soupçons.

M. Falconer pense qu'on peut établir l'authenticité d'une hâche d'après les caractères qu'elle présente. Il accorde une grande valeur aux preuves tirées du gisement; mais il dit qu'il y a des fraudes fréquentes et des erreurs possibles. Il reste convaincu que l'examen des échantillons taillés permet de décider s'ils sont ou s'ils ne sont pas authentiques. Si cette base lui était refusée pour son argumentation, il lui serait difficile d'aller ou delà. (11.)

M. Prestwich dit que lorsqu'il ne rencontre pas certains caractères dans les hâches en silex, il ne se croit pas autorisé à les regarder comme authentiques.

M. Busk demande à constater que dans la plupart des cas les caractères intrinsiques des hâches fausses permittent de reconnaître qu'elles sont frauduleuses. (12.)

MM. Desnoyers et Delesse rappellent que l'application des régles pour reconnaître les hâches fausses a donné des résultats très-divergents pour St. Acheul bien qu'il n'y eût absolument aucun doute.

M. le Président observe que, fréquemment, on peut reconnaître l'authenticité des hâches; tandis qu'il est beaucoup plus difficile de dire si elles sont fausses.

La séance est suspendue pendant une demi-heure, qui est consacrée à l'examen des échantillons; elle est reprise à 3 heures, 25 minutes. (13.)

M. Falconer pense que les hâches trouveés à Moulin-Quignon dans la couche jaune et qui sont sur le bureau sont authentiques; tandis qu'il déclare fausses toutes celles de la couche noire que sont soumises à l'examen de la réunion. Il présente une série de ces hâches ne la couche jaune, mais il fait remarquer que leur origine n'a pas été bien constatée; jusqu'à présent, elles n'ont pas été prises en place. Il présente également des échantillons de Saint Gilles et de Mautort, qu'il considére comme faux. Il admet que ceux du Moulin-Quignon le sont également. Il se base sur ce que la gangue se lave avec une très-grande facilité; sur ce que la forme et la taille de ces échantillons les rapproche des hâches frauduleuses; sur ce que la gangue paraît avoir été appliquée avec la main. (14.)

M. de Quatrefages présente les deux échantillons qu'il a rapportés de Moulin-Quignon, lesquels sont regardés comme faux par MM. Falconer et Prestwich. Il donne des détails sur les conditions dans lesquelles il a lui-même recueilli ces silex taillés. M. de Quatrefages affirme qu'on peut nettoyer d'une manière complète certains cailloux roulés de cette même couche et obtenir par le lavage un résultat analogue à celui donné par le lavage des hâches; par consequent, la possibilité de ce nettoyage ne prouve pas la non-authenticité des objets.

M. Prestwich, après avoir examiné les cailloux lavés de la sorte, reconnaît que la surface qui a été brossée dans l'eau a été bien nettoyée; mais il croit que l'échantillon est trop petit pour que l'on en puisse rien conclure. M. de Quatrefages répond que c'est le plus grand parmi ceux qui ont le caractère des hâches.

Relativement aux hâches trouvées par M. de Quatrefages, M. Prestwich ajoute que, à ses yeux, la hâche No. 1 est fausse et qu'il n'aurait pas pris pour une hâche authentique la hâche No. 2.

M. Falconer montre à la réunion des cailloux de la couche noire de Moulin-Quignon, qui offrent des dendrites. (15. 16.)

M. Delesse observe que la couche noire de Moulin-Quignon contient deux variétés de silex naturels qui ont des caractères bien différents. Les uns, et ce sont de beaucoup les plus abondants, ont des formes plus en moins arrondies, ils ont visiblement été transportés et roulés ; ils se distinguent surtout par leur couleur brune qui est due à ce que leur surface est fortement enduite et même imprégnée d'hydroxyde de fer et de manganèse. Les autres silex ont au contraire des formes anguleuses ; leurs arêtes sont vives, et, par suite, il est probable qu'ils n'ont presque pas été déplacés ; ils ont de plus une couleur blanche et un simple lavage à l'eau froide suffit pour les débarrasser bien completement des hydroxydes de fer et de manganèse qui les entourent, car leur surface n'en est aucunement imprégnée. M. Delesse présente des échantillons de ces deux variétés de silex qui sont les uns bruns, les autres blancs, et qui ont été obtenus en soumettant à une lévigation la couche noire de Moulin-Quignon. Il fait observer que les silex taillés qui ne sont pas imprégnés par les oxydes de fer et de manganèse à leur surface paraissent avoir été dans les mêmes conditions que les silex blancs et anguleux.

M. Delesse ajoute à cette occasion que, en exécutant la carte agronomique des environs de Paris, il a constaté que les terres végétales caillouteuses contiennent aussi deux variétés de silex, les uns bruns et arrondis, les autres blancs et anguleux. Il est facile de s'en assurer par la lévigation des terres végétales qui se trouvent sur les plateaux de Romainville, de Meudon, de Villejuif, de Villiers-sur-Marne, et c'est un fait général dans le Bassin de Paris.

M. Desnoyers dit que la surface des cailloux roulés est plus poreuse que la surface lisse des hâches, ce qui explique aussi pourquoi elle est plus imprégnée d'oxyde de fer. (17.)

M. Falconer observe que des essais qualitatifs de la couche noire, faits au laboratoire de M. le docteur Percy, à Londres, n'ont pas donné d'acide humique, en sorte que cette couche ne doit pas être considérée comme un ancienne terre végétale. (18.)

M. l'Abbé Bourgeois dit que la forme assez constante des hâches trouvées à Moulin-Quignon n'est pas une preuve qu'elles ne soient pas authentiques ; car ces haches étant vendues par plusieurs ouvriers, il serait fort étrange qu'elles eussent la même forme. (19.)

M. de Quatrefages met sous les yeux de la réunion une lamelle encore adhérente à la gangue. Cette lamelle dont la nature n'a pu être fixée d'une manierè précise, est blanche et ne présente aucune trace de coloration, bien qu'elle ait à peine 1 millimetre d'épaisseur. Il en conclut que la matière colorante de la gangue ne pénètre qu'à une très petite profondeur, et par conséquent, il n'est pas étonnant qu'elle n'ait pas coloré les silex taillés. (20.)

MM. Desnoyers, Lartet et Delesse déclarent que les hâches présentées par MM. Falconer et Prestwich, étant considérées en elles-mêmes et en dehors de leur gisement ainsi que de leur mode d'incrustation, n'ont aucun caractère suffisant pour qu'on puisse décider si elles sont fausses ou bien authentiques.

M. de Quatrefages remet sous les yeux de la réunion la hâche qu'il a trouvée, et dit qu'il ne lui paraît pas possible de produire artificiellement un dépôt de limonite comme celui qui l'enduit.

MM. Falconer, Prestwich et Busk résument leur opinion relativement aux hâches de la couche noire de Moulin-Quignon, en disant que ces échantillons ne présentent aucun des caractères nécessaires pour établir leur authenticité. M. Prestwich ajoute que, d'après leur forme générale ces hâches diffèrent un peu de celles qui sont considérées comme authentiques.

M. Busk ajoute que, sur les deux hâches de M. Quatrefages, une lui paraît indubitablement fausse ; (21) quant à l'autre, il réserve son opinion. En outre, il regarde comme fausses les hâches de Moulin-Quignon qu'on dit extraites de la couche noire.

M. Desnoyers fait observer que la forme générale de ces haches présente une grande analogie avec l'un des types des hâches considérées comme les plus authentiques.

M. de Quatrefages rappelle que la lamelle blanche noyée dans la gangue colorante est restée entièrement blanche. D'un autre côté, toutes les observations de M. Busk portent seulement sur la hâche que M. de Quatrefages a abandonnée dès l'origine, déclarant qu'elle était douteuse. Quant à l'autre hâche, M. Falconer lui-même l'a acceptée comme ayant une bonne forme, et M. de Quatrefages l'a prise lui-même en place, lorsqu'elle était encore engagée dans la couche noire.

M. Falconer présente ensuite la dent qui lui a été remise par M. Boucher de Perthes lui-même. (22)

M. de Quatrefages observes, relativement à cette dent que, d'après des détails à lui transmis par M. Boucher de Perthes, ce dernier n'a jamais cru pouvoir répondre de cette dent, et qu'il lui reste des doutes sur son gisement.

M. Falconer met sous les yeux de la réunion la boîte qui contenait cette dent, avec l'étiquette écrite de la main de M. Boucher de Perthes; mais il ajoute qu'il y a probablement un malentendu à cet égard.

M. Delesse observe que les dents du terrain diluvien contiennent encore en proportion très-notable de matières organiques. Il met sous les yeux de la réunion une dent sciée d'*hyèna spælea*, trouvée à Anvers, qui en renferme encore beaucoup. Il a constaté qu'une dent de *hyèna spælea* provenant du même gisement retient encore 22 millièmes d'azote.

M. de Quatrefages soumet à l'attention des membres de la réunion la mâchoire humaine trouvée à Moulin-Quignon par M. Boucher de Perthes. (23.)

M. Busk dit qu'il ne voudrait pas émettre de prime abord une opinion formelle sur l'authenticité de la mâchoire. Il demande cependant si la gangue qui l'entoure n'aurait pas été appliquée artificiellement; car il croit trouver dans certaines stries la trace d'un linge on d'une brosse.

MM. Busk et Falconer déclarent d'ailleurs qu'ils ne peuvent se prononcer sur la mâchoire avant qu'elle n'ait été sciée et lavée.

M. de Quatrefages dit qu'il serait désirable de conserver encore une partie de la mâchoire avec la gangue adhérente, et il propose d'en scier une plaque qui sera lavée et examinée.

La séance est levée à 6 heures du soir.

Séance du 11 *Mai*, 1863.—*Présidence de M. Milne Edwards.*

Sont présents: MM. Falconer, Busk, Carpenter, Prestwich, Desnoyers, de Quatrefages, Lartet, Gaudry, l'Abbé Bourgeois, Buteux, Daubrée, Alphonse Milne Edwards et Delesse.

M. Hébert qui assiste à la conférence préliminaire, avant l'ouverture de la séance, examine la mâchoire ainsi que le silex taillé trouvé par M. de Quatrefages et dit qu'il considére le depôt qui les recouvre comme bien naturel. (24.)

La séance est ouverte à 9 heures sous la présidence de M. Milne Edwards, M. Delesse remplissant les fonctions de secrétaire.

M. Delafosse qui veut bien se rendre dans la Commission à la demande de M. le Président, examine avec soin la mâchoire et déclare que le dépôt qui la recouvre lui parait être parfaitement naturel.

M. le Président demande ensuite à M. Delafosse s'il croit qu'un pareil dépôt puisse se former rapidement et sur une mâchoire introduite frauduleusement dans la couche d'où on l'a extraite.

M. Delafosse repond négativement; il pense qu'un pareil dépôt ne saurait être fabriqué en quelques semaine. (25.)

M. de Quatrefages soumet la hâche qu'il a trouvée en place à M. Delafosse qui déclare que la gangue lui parait être la même que celle de la mâchoire et provenir également d'un depôt lent et naturel. (26.)

M. Busk présente alors à M. Delafosse un silex taillé provenant de Mautort et recueilli par M. Boucher de Perthes en 1862. M. Delafosse pense encore quele dépôt qui le recouvre est naturel. (27.)

M. Delafosse examine une hâche de Moulin-Quignon qui est produite par M. Falconer; il declare qu'il ne soit aucune raison pour penser que la gangue ait été appliquée artificiellement, bien que ce soit moins net. (28.)

M. Busk présente un échantillon de Mautort sur lequel ou voit des stries en différents sens. M. Delafosse ne croit pouvoir se prononcer sur leur origine.

M. Busk présente une hâche de St. Gilles à M. Delafosse qui répond que la gangue qui la recouvre peut bien être ancienne, mais qu'il ne saurait le garantir.

M. de Quatrefages observe relativement à cet échantillon, qu'on y voit des fragments de végétaux. Sur certains points on retrouve les mêmes fibrilles qui examinées par M. Carpenter ont été reconnues pour des radicelles de végétal acotyledon et qui provenaient du plancher même de la gangue. Sur un point se voit un fragment de paille appliqué. Mais là la gangue présente un aspect différent. On comprend qu'au moment de la trouvaille et quand la gangue était encore humide des fragments de végétaux récents y aient adheré.

M. Busk croit que tous les débris végétaux sont d'origine récente.

M. Carpenter adresse ensuite à M. Delafosse la question suivante. Des silex taillés en nombre considérable, une vingtaine, peuvent-ils avoir séjourné dans la couche de gravier argilo-ferrugineux depuis son dépôt, sans avoir contracté une coloration ou sans presenter des dendrites, les cailloux ordinaires de cette couche offrant en général ce caractère ? (29.)

M. Delafosse répond que l'absence de cette coloration et à plus forte raison des dendrites sur des silex taillés et à surface lisse ne lui paraît pas un argument susceptible d'être invoqué en faveur de la non authenticité de ces objets.

A ce sujet M. de Quatrefages demande à rappeller que sur un même caillou roulé on trouve des surfaces colorés par le fer et d'autres qui sont lisses et n'ont aucun indice de coloration. Il pense que cette coloration ocreuse était antérieure au dépôt.

M. de Quatrefages demande aux membres de la réunion de se prononcer sur les caractères du dépôt qui recouvre la mâchoire.

M. Busk déclare qu'il ne voit aucune raison pour penser que le depôt soit ancien.

M. le Président lui demande alors s'il a quelques motifs de croire que ce soit récent. Il répond affirmativement et il se fonde sur l'existence de stries semblant indiquer des coups de brosse qu'on voit particulièrement sur la surface externe de la mâchoire. (30.) Monsieur Falconer partage sur les deux [ces] points l'opinion de M. Busk.

M. Prestwich pense que le dépôt recouvrant la mâchoire est de même nature que la substance de la couche noire ; mais qu'il faudrait des expériences directes pour décider combien de temps serait nécessaire pour avoir un pareil depôt. Il pense que quelques semaines au moins seraient indispensables et peut-être un temps beaucoup plus long. M. Prestwich ajoute qu'un pareil résultat pourrait aussi être obtenu, soit en introduisant la mâchoire dans la couche même, soit en la mettant dans une masse tirée de la couche noire.

M. de Quatrefages demande à M. Prestwich s'il croit que la couche revêtant la mâchoire ait pu être formée en enduisant l'os avec de la gomme ou bien avec de la colle et en appliquant par dessus de l'argile extraite de la couche noire.

M. Prestwich ne pense pas que cela ait pu être fait de cette manière. Il ajoute relativement aux stries que si leur existence peut s'expliquer comme l'a fait M. Busk l'on peut aussi les attribuer à un glissement dans la carrière. (31.)

M. le Président dit qu'il serait nécessaire d'examiner au microscope la surface de la mâchoire, afin de reconnaître si le depôt qui la recouvre consiste seulement en grains ou bien est moulé sur sa surface et présente les caractères d'un sédiment formé lentement par les eaux. On procède immédiatement à cet examen.

M. de Quatrefages fait voir sous le microscope d'abord l'émail de la dent puis une portion de la mâchoire qui a été lavée. Il montre sur l'une est sur l'autre des plaques noirâtres d'un aspect métallique qui lui paraissent démontrer de la manière la plus nette que ce depôt n'a pu être fait artificiellement en employant de la gomme, de la colle ou toute autre substance propre à faire adhérer des matières terreuses. De plus ces plaques excessivement minces sont parfaitement moulées sur toutes les anfractuosités, soit de l'os, soit de la dent et elles présentent une homogenéité de structure qui ne lui semble être explicable que par une formation très longue. (32.)

M. Desnoyers ajoute que plusieurs de ces incrustations adhérentes à la mâchoire présentent un éclat métallique et une surface mammellonnée.

M. l'Abbé Bourgeois observe que ces incrustations sont semblables à celles des silex bruns.

MM. Busk et Falconer déclarent reserver leur opinion jusqu'à ce qu'une surface plus étendue de la mâchoire ait été lavée.

M. Prestwich pense que les incrustations qu'il a vues sur la portion déjà lavée de l'os résultent d'une action lente et qu'elles sont d'apparence métallique.

M. le Président interrompant pour un instant la discussion sur les points fondamentaux demande à revenir sur la valeur des caractères sur lesquels s'est prononcé M. Falconer relativement à la dent qui lui a donné M. Boucher de Perthes; ces caractères son de deux sortes, les uns physiques les autres chimiques. (33.)

M. Alphonse Edwards met sous les yeux de la réunion un dent incisive d' *Ursus spœleus* trouvé dans le terrain diluvien inferieur de Compiègne, laquelle ayant été traitée par l'acide chlorhydrique faible laisse voir une grande proportion de gélatine.

M. Delesse dit qu'il a constaté aussi que les dents et les os provenant des cavernes et du terrain diluvien peuvent être très bien conservés et contenir beaucoup de matière organique; il y a trouvé notamment beaucoup d'azote.

M. Falconer repond qu'il s'est prononcé surtout d'après l'ensemble des caractères offerts par la dent: savoir la blancheur qu'elle présente dans sa section, son aspect satiné, sa grande proportion de gélatine son apparence de fraicheur, et la circonstance qu'elle ne happe pas à la langue. M. Falconer ajoute que c'est surtout l'absence d'infiltration de matière ferrugineuse et manganesifère qui a determiné sa conviction; il ne peut concevoir qu'une dent séjourne aussi longtemps au milieu des oxydes métalliques qui l'enveloppent sans être plus ou moins penetrée par ces oxydes.

M. de Quatrefages dit que les quatre raisons indiquées par M. Falconer se reduisent en définitive à deux, car l'absence de happement et l'aspect satiné tiennent à la présence de la gelatine. Si celle-ci manque il est evident que les deux caractères précedents disparaitront. On a repondu en ce qui touche la présence de la gélatine; reste la question de—coloration. Il rappelle à ce sujet que nous possédons un fragment resté parfaitement blanc et qui adhère encore à un morceau du plancher de la couche noire. (34.) Ainsi le fait prouve que l'absence de coloration n'a pas la signification qu'on lui attribue. D'ailleurs il est clair que la coloration externe des corps dépend de la nature de la matière colorante. Si celle-ci est insoluble elle s'arrêtera à la surface, y formera des concretions mais elle ne pénétrera pas la substance même des os ou des silex car il faudrait, pour cela qu'elle fût à l'état liquide.

M. Delessè met sous les yeux de la réunion des dents fossiles provenant du terrain diluvien d'Anvers qui appartiennent à une espèce perdue, la *Hyæna spelea.* Cet dents qui out été scieés sont tres bien conservées; elles présentent encore la blancheur et l'éclat satiné de dents fraîches et même l'une d'elles ne happe pas à la langue.

M. Falconer observe que l'une de ces dents happe beaucoup et que si l'autre ne happe pas, elle a cependant pris une couleur un peu jaunâtre. (35.)

M. Busk présente alors differents échantillons de dents provenant des tourbières, et quelques unes appartenant probablement aux temps historiques; il faut remarquer qu'elles ont une coloration très marquée. Cette coloration de la dentine se propage de la cavite médullaire de la dent vers la periphérie. Dans un échantillon provenant d'une sepulture gallo-romaine de St. Acheul, des traces de cette coloration sont visibles et dans quelques cas elle est due à une matière ferrugineuse. (36.)

M. Falconer produit ensuite une mâchoire trouvée dans une carrière de Suffolk dans laquelle on exploite le crag; il fait remarquer qu'elle est pesante et de couleur brun noirâtre. (37.)

M. Busk a mis ces échantillons de dents sous les yeux de la réunion dans le but de montrer que la non-coloration des dents placées dans la couche noire est bien improbable en présence de la coloration acquise par des dents beaucoup plus recentes.

M. de Quatrefages dit que personne ne refusera d'admettre que les dents puissent se colorer profondement dans un temps très court; mais cela depend de la solubilite de la matière colorante.

M. Delesse dit que les os fossiles sont frequemment alterés lorsqu'ils sont enfouis dans des couches contenant de l'oxyde de fer; c'est ce qui a lieu notamment pour les os des faluns qui ont pris une couleur brune et un' eclat lustré ; toutefois cette métamorphose ne s'est pas toujours produite. M. Delesse en cite comme preuve les cavernes de Franche Comté qu'il a eu souvent l'occasion de visiter. Les os qu'elles renferment sont généralement enveloppés par un limon rouge très ferrugineux et cependant un simple lavage les debarasse facilement de leur gangue et les rend entièrement blancs. On comprend d'ailleurs que pour qu'un os soit impregné ou pseudomorphosé par de l'oxyde de fer, il ne suffit pas qu'il soit enfoui dans de couches qui en contiennent; cette condition n'est même aucunement nécessaire, mais il est indispensable qu'il soit imbibé par des eaux ferrugineuses.

M. Alphonse Edwards dit que les conditions extérieures et les matières organiques jouent un grand rôle dans la coloration des os. A. Sansan, par exemple, les os sont colorés d'une manière très inégale dans des couches différentes.

M. le Président dit que des os ou des dents peuvent être colorés d'une manière très inégale suivant qu'au moment de l'enfouissement, ces objets étaient plus ou moins privés de matière organique; par conséquent, toutes les autres conditions d'enfouissement étant d'ailleurs les mêmes, on aura des resultats bien différents au bout d'un même temps.

M. Lartet remarque que les os trouvés dans la Seine sont généralement colorés parcequ'ils y ont été jétés à l'état frais. Il n'en est pas de même pour les os des cavernes.

M. Milne-Edwards, President de la réunion, observe que le ciment est le plus souvent seul coloré.

M. Alphonse Milne-Edwards dit qui si l'on met un morceau de fer dans un vase dans lequel on fait macerer des os frais, ces os se colorent rapidement en noir.

M. Prestwich dit que vu l'état des couches, leur perméabilité et la présence de l'oxyde de fer, il lui parait impossible que la dent sciée par M. Falconer provienne de la couche noire du Moulin-Quignon.

M. Desnoyers ramenant la discussion sur l'examen microscopique de la machôire, demande à MM. Prestwich, Falconer, Busk et aux autres membres de la réunion si l'aspect métallique déjà signalé précédemment n'est par parfaitement visible. (38). Ces messieurs repondent affirmativement, M. Daubrée, Professeur de Géologie au Muséum qui a examiné la mâchoire a constaté également l'aspect métallique du dépôt qui l'entoure.

M. Buteux donne un renseignement important relativement à l'exploitation de Moulin-Quignon. Il dit que la couche noire dans laquelle a été trouvée la mâchoire est accidentelle et qu'elle a été decouverte seulement cette année. Elle est locale et manque à une petite distance.

M. Prestwich repond qu'il a déjà observé à Moulin-Quignon d'autres amas ou des couches analogues à celles dans laquelle a été trouvée la mâchoire.

A ce moment de la Séance M. de Quatrefages est obligé de la quitter, appellé ailleurs par un devoir imperieux.

M. le Président donne avis qu'on va procéder à l'examen de la mâchoire; elle est remise à M. Busk qui se charge de la scier transversalement. Cette opération terminée M. Busk dit que l'os est très ancien mais qu'il ne présente aucun caractère qu'on ne rencontre dans des os provenant de cimetières. Il ajoute que le canal parcouru par l'artére dentaire est partiellement rempli par un sable gris. La portion de la surface exterieure qui a été lavée lui parait présenter le même aspect qu'un os du cimetière de St. Acheul. De plus, la matière noire qui recouvrait la mâchoire s'est laissée enlever presqu'entièrement par le lavage et l'os n'est par teint profondement par la matière ferrugineuse. (39.)

En absence de M. de Quatrefages, M. le Président fait remarquer que la section qu'on vient de pratiquer a mis a découvert le fond de l'alvéole occupé par une dent molaire et que la gangue se trouvant à l'extérieur de l'os est deposée et adhère même assez fortement, d'une part à la surface des racines de la dent, d'autre part aux parois de la cavité alvéolaire, en laissant dans l'intervalle un espace vide; que plusieurs de ces concretions ont pénétré jusque dans les cellules du diploé adjacent. Il fait remarquer aussi que la portion superficielle de l'os maxillaire est d'un tissu très dense, ce qui dépend probablement de l'âge du sujet et que cette circonstance peut expliquer le peu de pénétration des matières etrangères dans l'intérieur de l'os. Le diploé lui parait peu alteré; mais il pense que le temps écoulé depuis la mort de l'individu et l'époque actuelle a du être très long. Le dépôt contenu dans le canal de l'artère dentaire, lui parait provenir d'un sejour plus ou moins prolongé de l'os dans de l'eau non chargée d'oxyde de fer. Sur la surface qui a cependant été lavée à plusieurs reprises, avec une brosse à dent et un chiffon on aperçoit encore très directement des taches ferrugineuses. Il remarque ensuite que la gangue extérieure a pénétré profondement dans le trou mentonnier et que malgré le lavage il reste encore des traces de la gangue dans toutes les depressions miliaires de la surface lavée.

M. Prestwich dit que l'état de fossilisation de la mâchoire ne lui parait pas en rapport avec la nature de la couche dans laquelle on l'a trouvée.

MM. Falconer et Busk déclarent partager l'opinion de M. Prestwich.

La Séance est levée à 2 heures et demie.

Séance du 12 *Mai*, 1863.—*Présidence de M. Milne Edwards.*

La Séance est ouverte à l'hôtel de la Tête de Bœuf, à Abbeville, vers 7 heures du soir. M. Delesse, secrétaire, donne successivement lecture des procès-verbaux des deux séances precédentes qui sont approuvés à l'unanimité.

Dès la matinée du 12 Mai, les Membres de la réunion s'étaient rendus à Abbeville afin de procéder à l'examen de la carrière de Moulin-Guignon.

Etaient présents : MM. Boucher de Perthes, Milne Edwards, Prestwich, Busk, Desnoyers, de Quatrefages, l'Abbé Bourgeois, Delanoue, Alph. Edwards, Dimpre.

Un peu plus tard se sont joints à eux : MM. Falconer, Lartet, Delesse, Hébert, de Vibraye, Garrigou, Vaillant, Bert et Marcotte. (40.)

Ces Messieurs étaient accompagnés de M. Hersent Duval, propriétaire de la carrière qui a facilité de tout son pouvoir les recherches de la réunion. On constate d'abord que l'exploitation se fait en attaquant à la pioche une paroi verticale de graviers alternant avec quelques lits minces de sables fins et qui a divers niveaux sont mélangés avec un peu d'argile; on fait ainsi tomber au pied de l'escarpement de grandes masses de déblais que l'on rejette ensuite à la pelle du côté opposé au front de l'exploitation, de façon à remplir d'un côté la trancheé à mesure qu'on la vide de l'autre. Le front de l'exploitation qui se développe sur environ trente mètres de longueur est ainsi continuellement renouvelé. (41.) On ne pourrait donc y introduire frauduleusement et longtemps à l'avance des objets préparés sans être obligé d'interrompre les travaux d'exploitation. (42.)

La Réunion a commencé par faire déblayer complètement le front de l'exploitation des graviers qui avaient déjà été abattus.

Un ouvrier annonce avoir trouvé le matin même au milieu de ces graviers une hâche ou ce qu'il nomme avec raison un *coin*, et il le remet entre les mais de l'un des Membres de la réunion.

Après avoir mis à nu la surface de la craie on constate, immédiatement au-dessus, l'existence de la couche noire qui est peu développée dans ce point. Immédiatement au-dessus de la couche noiré, se trouve un lit de sable argileux fin et de couleur grise, qui, par ses caractères physiques, ne paraît différer en rien du sable quartzeux gris dont on a constaté la présence dans le canal de l'artère dentaire de la mâchoire qui a été trouvée au milieu de la couche noire. (43.)

M. le Président fait remarquer que cette circonstance lui parait expliquer la présence du sable gris dont il avait parlé dans la Séance précédente, comme étant de nature à faire penser que la mâchoire avait pu séjourner dans une couche non colorée avant son introduction dans la couche dans laquelle on l'a rencontré ou avant la coloration de celle-ci.

M. Delesse ne s'explique pas bien comment le sable qui recouvre la couche noire aurait pu s'introduire dans le canal de l'artère dentaire;

car la limonite entoure la surface de la mâchoire et elle bouche même complètement l'ouverture de ce canal. De plus la couche de sable gris est entièrement différente de la couche noire ; elle contient de petits galets bien arrondis, tandis que les silex de la couche noire sont à angles vifs et très peu roulés ; elle indique donc un dépôt qui s'est formé dans des conditions tout autres que la couche noire et sans doute à une époque bien postérieure. M. Delesse pense d'après cela que le sable gris se trouvant dans le canal de l'artère dentaire correspondrait plutôt à une première période de l'enfouissement et la gangue ferrugineuse qui l'entoure à une seconde période.

M. Prestwich remarque qu'il n'est pas nécessaire d'admettre pour expliquer ce fait que la mâchoire ait été introduite dans la couche, ni qu'elle y ait changé de place ; il conçoit que la coloration tant de la couche que celle de l'os ait pu se faire après l'enfouissement de l'os, cequi a permis que la matière sableuse du canal de l'artère préalablement introduite soit soustraite à son action et n'ait que [pu ?] pénétrer dans ce canal.

M. Lartet partage l'avis de M. Delesse.

M. de Quatrefages fait remarquer qu'en fait on trouve de la limonite recouvrant et bouchant l'orifice extérieur du canal de l'artère dentaire et celui du trou mentonnier. La présence d'une matière non colorée dans l'intérieur du premier s'expliquerait très naturellement en admettant qu'elle a pénétré au moment même où l'os était roulé par un courant tenant en suspension du sable très fin. Un gravier un peu plus gros ou un peu d'argile fermant en un point quelconque le canal et cimenté ensuite par la limonite suffit pour se rendre compte de la non coloration de la partie profonde du canal.

M. Falconer, vu la nature colorante et perméable de la couche noire, trouve qu'il est difficile de comprendre la non-introduction de la nature colorante dans la partie profonde du canal de l'os ; car l'enduit de sable gris n'était appliqué que sur les parois du dit canal et ne l'obstruait pas complètement.

A cette occasion M. l'Abbé Bourgeois présente une hâche montrant une cavité sur l'une de ses faces. Cette cavité est d'environ un centimètre, largement ouverte et elle loge dans une anfractuosité de sa partie profonde du sable gris, semblable en tout à celui du canal de la mâchoire et de la couche grise ci-dessus mentionnée ; or, la hâche présentée par M. l'Abbé Bourgeois a été recueillie dans la couche noire le 10 avril dernier ; par suite il pense que, dans ce cas, ainsi que dans le cas de la mâchoire, l'entrée de cette cavité avait été obstrueé par une matière argileuse. Ces deux faits peuvent donc s'expliquer de la même manière ; et l'authenticité reconnue de la hâche entraîne nécessairement celle de la mâchoire.

M. Busk pense que l'eau qui circulait dans la couche ne contenait pas de matières colorantes solubles, ce qui impliquerait la non coloration du sable du canal de la mâchoire, ainsi que celle de l'os. Comme les cailloux de la couche noire sont fortement colorés, leur coloration peut donc se rattacher à des causes antérieures a leur dépot. (44.)

M. de Quatrefages rappelant que l'on a constaté que des cailloux étaient colorés sur une de leurs faces et non sur l'autre en conclut que la coloration était antérieure au dépôt et que par conséquent on ne peut en tirer aucun argument contre la contemporanéité de la mâchoire et du dépôt.

M. Busk ajoute que dans son opinion la coloration ocreuse des matières de la couche pourrait peut-être dépendre de la présence de sels de fer solubles ou de la décomposition des pyrites de fer sous l'influence des matières organiques ou bien de quelque autre cause—qui amènerait un resultat analogue.

M. Desnoyers et M. Delesse pensent que l'association de l'hydrate de fer avec l'oxyde da manganèse éloigne l'idée d'une décomposition des pyrites.

M. le Président fait alors le compte-rendu des recherches qui ont été exécutées à la carrière de Moulin-Quignon. Elles ont eu lieu de 9 heures du matin à 4 heures du soir avec le concours de 16 ouvriers qui ont travaillé sous la surveillance très active des Membres de la réunion. Ces recherches ont amené la découverte successive de 5 háches. (45.)

La hâche No. 1, trouvée à un mètre au dessus de la craie dans une poignée de graviers, sous les yeux de M. Alph. Milne Edwards par l'ouvrier Vasseur.

La hâche No. 2, trouvée au contact même de la craie par M. Albert Gaudry et à 1m. 50 de deux puisards traversant dans cet endroit le gravier de la carrière.

La hâche No. 3, trouvée par l'ouvrier Duchaussoy à 50 contimètres au-dessus de la craie et à 20 centimètres de l'un des puisards, M. Bert étant présent.

La hâche No. 4, trouvée par M. le Président dans un petit tas de sable et de cailloux que l'ouvrier venait de détacher sous ses yeux d'une paroi à pic placée à peu près à 1m. au-dessus de la craie, vers l'extrêmité sud de la carrière; cette hâche était environ à 25m. de la précédente et du puisard dont il viént d'être question.

La hâche No. 5, aperçue en place par M. Alph. Milne Edwards, à environ 30 centimètres de la craie et à 5m. de la précédente, c'est à dire à 20m. environ du dernier puisard. Avant de détacher cette hâche, tous les Membres de la réunion qui étaient présents ont été invités à constater son gisement. Cette constatation a été faite par MM. Falconer, Delanoue, Desnoyers, Lartet, Milne Edwards, Gaudry, l'Abbé Bourgeois et Garrigou.

M. le Président fait remarquer que sur les cinq échantillons quatre lui paraissent offrir les caractères des échantillons sur l'authenticité desquels des doutes avaient été élevés dans les dernières Seánces. Le No. 2, différe seul des précédents par sa forme générale et ressemble à ceux trouvés plus anciennement dans la même carriere, revêtus d'une patine et tous admis antérieurement comme authentiques par tous les Membres de la réunion.

M. le Président ajoute que lors même qu'il existerait quelque différence entre les hâches trouvées aujourd'hui et celles dont on a constaté précédemment l'authenticité, toute discussion sur ce dernier point deviendrait maintenant inutile, attendu que l'existence de silex travaillés de main d'homme dans la couche dont on a retiré la mâchoire lui paraît parfaitement démontrée par les faits constatés aujourd'hui. Il demande l'opinion des différents Membres de la commission sur ce dernier point et sur l'authenticité de la découverte de la mâchoire trouveé par M. Boucher de Perthes dans la couche noire de la carrière de gravier du Moulin-Quignon.

M. Prestwich déclare que bien qu'il n'ait pas assisté à la mise à nu des hâches, prenant en considération le soin extrême avec lequel l'opération à été dirigeé et surveilleé, il n'élève plus aucun doute sur l'authenticité [*de ces hâches*] et de la plupart des hâches [*de celles*] contesteés dans les réunions antérieures, y compris les 2 échantillons trouvés par M. de Quatrefages.*

De plus la réunion est unanime pour accepter l'authenticité des hâches trouvées aujourd'hui. (46.)

Quelques Membres demandent une nouvelle conférence avant de se prononcer définitivement sur l'authenticité des haches desquelles il a été question dans les procès verbaux des séances précédentes. (47.) En conséquence la proposition faite par M. le Président sera discuteé demain.

La Séance a été levée à 2 heures du matin.

Séance du 13 *Mai*, 1863.—*A l'Hôtel de la Tête de Bœuf à Abbeville.—Présidence de M. Milne Edwards.*

Sont présents MM. Prestwich, Falconer, Busk, de Quatrefages, Desnoyers, Lartet, Delesse, Garrigou, Alphonse Milne Edwards.

On fait comparaître Charles Isidore Vasseur, ouvrier carrier, qui le 28 Mars dernier, a trouvé la mâchoire en place. Il en a informé immédiatement M. Boucher de Perthes qui s'est transporté sur les lieux avec MM. Dimpre père et Dimpre fils et qui l'a retirée du gravier de ses propres mains. Pour recompenser Vasseur, M. Boucher de Perthes lui a remis cinq francs, et lui a promis une somme double s'il decouvrait (selon les termes employés par l'ouvrier) un autre os de chrétien. Mais Vasseur déclare que jusqu'ici il n'a trouvé aucun nouvel os dans le gravier.

Il ajoute que presque toutes les hâches qu'il a decouvertes étaient dans la couche noire et situées immédiatement audessus de la craie. Il dit que la couche noire devient quelque fois jaunâtre.

M. Busk appelle l'attention de la réunion sur le caractère d'un petit dépôt qui s'est fait accidentellement sur l'ivoire de son canif qui présente des réflets métalliques, et qui adhère fortement à sa surface. Des taches semblables, mais plus petites, recouvrent aussi sur certains points la lame de ce même canif. Ces taches sont formées par la gangue de la couche noire qui recouvre immédiatement le craie. elles ont accidentellement adhéré sur le canif pendant que M. Busk s'en servait pour dégager un echantillon. Bien que M. Busk ait porté ce canif dans sa poche depuis hier ces taches ont continué y adhérer.

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* The words in Italics are not in the original.

M. de Quatrefages fait remarquer qu'ayant examiné à la loupe les taches dont vient de parler M. Busk et avant même de connaître leur origine, il les a declarées très différentes des concrétions adhérentes à la mâchoire et aux silex taillés. Tout au plus, pourrait-on trouver une certaine analogie entre les taches qui adhèrent à l'ivoire du canif et quelques points les plus superficiels de la gangue de la mâchoire et des silex. (48.)

Après l'interrogatoire de Vasseur on passe à l'ordre du jour.

M. le Président après avoir résumé la discussion met aux voix la conclusion suivante. (49)

1. La mâchoire en question n'a pas été introduite frauduleusement dans la carrière du Moulin-Quignon ; elle existait préalablement dans l'endroit où M. Boucher de Perthes l'a trouvée le 28 Mars dernier. (50.)

Cette conclusion est adoptée à l'unanimité.

2. Tout tend à faire penser que le dépôt de cette mâchoire a été contemporain de celui des cailloux et autres matériaux qui constituent l'amas argilo-graveleux désigné sous le nom de couche noire laquelle repose immédiatement sur la craie.

Cette conclusion a été adoptée par tous les membres presents a l'exception de MM. Falconer et Busk, qui déclarent reserver leur opinion jusqu'à plus ample informé. (51.)

3. Les silex taillés en forme de hâches qui ont été présentés à la réunion comme ayant été trouvés vers la même époque dans les parties inférieures de la carrière du Moulin-Quignon sont pour la plupart, sinon tous, bien authentiques. (52.)

Cette troisième conclusion a été adoptée par toutes les personnes présentes sauf par M. Falconer qui reserve son opinion jusqu'à plus ample informé.

4. Il n'y a aucune raison suffisante pour revoquer en doute la contemporanéité du dépôt des silex taillés avec celui de la mâchoire trouvée dans la couche noire.

Cette proposition est adoptée par tous les membres de la réunion sauf par MM. Falconer et Busk qui désirent reserver leur opinion.

M. Busk désire ajouter que quoique de l'opinion mentionnée ci-dessus, et jugeant à raison de la condition extérieure de la mâchoire et d'autres considerations d'une nature plus circonstantielle qu'il n'y ait plus raison de douter que l'os n'ait été trouvé dans l'endroit et dans les conditions racontées par M. Boucher de Perthes; néanmoins, il lui semble que sa condition interne ne s'accorde pas de tout avec la supposition qu'il soit de la même antiquité que celle qu'on attribue aux couches dans lesquelles le dit os a été trouvé.

M. Falconer dépose ensuite sur le bureau la déclaration suivante.
" I am of opinion that the finding of the human jaw at Moulin-
" Quignon is authentic; but that the characters which it presents
" taken in connexion with the conditions under which it lay are not
" consistent with the said jaw being of any very great antiquity. (53.)
(Signé) " H. FALCONER.
" Abbeville, 13 Mai, 1863."

Les membres de la réunion remercient M. le President de l'impartialité avec laquelle il a dirigé leurs travaux et ils le prient de vouloir bien rendre compte des resultats de cette enquête à l'Academie.

Ont signé,
A titre de membres du congrès:
MM. FALCONER.
PRESTWICH.
BUSK.
DE QUATREFAGES.
DESNOYERS.
LARTET.
DELESSE.
MILNE-EDWARDS, Président.

Comme témoins appellés à prendre part à l'enquête :
MM. L'ABBÉ BOURGEOIS.
GAUDRY.
DELANOUE.
GARRIGOU.
ALPHONSE MILNE-EDWARDS.

La Séance est levée à 10h. 30m.

MILNE-EDWARDS, Président.

DELESSE, Secrétaire.

NOTES, &c.

As already stated, no short-hand writer was present at the sittings to take down *in extenso* the remarks of the different speakers. During the first three meetings held in Paris, and at which alone he was present, (having been prevented from proceeding to Abbeville by official duties which required his return to London,) Dr. Carpenter, at the desire of Dr. Falconer and Mr. Busk, and with the concurrence of M. Delesse, took copious notes of the debates. This was the more necessary, as the remarks made by some of the members were occasionally expressed in English. Of the running commentary which follows, the portions copied from Dr. Carpenter's original notes are authenticated with his initials. The rest, being either in explanation or amplification of the record given in the "*procès verbaux*," bear the initials of Mr. Busk or of Dr. Falconer.

Note 1.—Scales not absolutely deficient, but less numerous and less perfectly preserved. (W. B. C.)

Note 2.—The distinctive characters of the spurious *hâches* were then given by Dr. Falconer in corresponding detail. (W. B. C.)

Note 3.—No genuine *hâche*—so accepted by all the members—found at Moulin-Quignon shows films. They have all been rubbed off. (H. F.)

Note 4.—Dr. Falconer observed that in these cases such fractures may have been caused by recent blows. (W. B. C.)

Note 5.—In another specimen of the matrix a brownish hair of the same kind was afterwards discovered. Two of the former objects were determined by Dr. Carpenter as being "apparently radical fibres of plants." (W. B. C.)

Chemical and microscopical examination of the "black matter" from Moulin-Quignon has shown that it does not contain the minutest trace of organic matter. The occurrence, therefore, of the few particles of vegetable and animal tissues here referred to must be regarded as accidental. With respect to the vegetable particles, there is every reason to believe that they were derived from the soft grey paper used for wrapping the specimens in; and as regards the few hairs, though they have not been so satisfactorily traced, there can be no doubt that their presence was equally fortuitous. (G. B.)

Note 5*a*.—Mr. Prestwich's letter was read in full at the meeting, but the abstract was not inserted until after the close of the Conference. It was therefore not read before him, and has been inserted in the text without the revision which it would otherwise have received. The following is a correct abstract of the points indicated by Mr. Prestwich.

1. Their shape, upon a type *different* (only slightly) from all others previously found at Abbeville or Amiens.
2. The *sharpness of all their angles*, whereas all the specimens I had previously seen from Moulin-Quignon, showed *more wear than the specimens from any other locality*, except La Porte Mercadé.
3. The entire absence of *staining and discoloration*, except such slight effect as might be produced by a few days contact with the matrix, whereas I had never before seen one specimen out of six (if so much) but what was *much stained and permanently discoloured*, usually *brown*—at times with traces of *black*.
4. The absence of all *dendritic markings*, and of any portion, however small, of the *matrix adhering*. Such absence is most unusual.
5. The great number of the specimens. I had been before some six or eight times to Moulin-Quignon, and had never been present at the discovery of a single specimen, nor had the workmen any to offer me.
6. The evident soiling of all the specimens, as though they had been put in gravel and then water thrown over them, or as if they had been taken in the hands and rubbed with wet gravel and sand. In fact on two specimens I have seen distinct streaks produced by the passing of gritty particles over a wet surface of adhering matrix.

These are my chief reasons. On the other hand I must admit that I have seen two specimens which have the appearance I assign to the false ones, and which yet show on one side a certain amount of wear. Some few specimens also are so close to the genuine forms, that it is most difficult to distinguish them. . . . . I am still satisfied that there is an imposition in some, if not the greater part of the flint implements, and that of course throws a doubt in my mind on the whole affair. The ultimate conclusions must, however, depend upon a close examination and analysis of the jaw, and in the able hands in which the matter now rests I have no doubt the truth will be elicited.

Note 6.—The specimen in question was one of the factitious looking *hâches* procured by the Messrs. Brady at Moulin-Quignon on the 17th April. It was carefully washed by Dr. Falconer in the presence of Dr. Murchison and the Messrs. Brady, and immediately afterwards a very distinct fresh iron streak was observed on one of the surfaces by all present. The following day Dr. Carpenter subjected it to the microscope, and detected grains of metallic iron on the streaked surface. The specimen had every character of modern fabrication. (H. F.)

Note 7.—Mr. Prestwich, who has had such an important share in all the researches connected with the quaternary deposits of the valley of the Somme, and their bearing on the antiquity of human relics in Europe, unexpectedly joined the conference at the second *séance*.

Note 8.—The specimen in question was variegated with greyish white portions, of a porous texture, yielding a corresponding fracture, and retaining minute specks of the matrix on the inequalities of the surface. Such at least was the view held by the English members. Dr. Falconer considered that there was no real difference between the original surface and the dull fresh fracture. (H. F.)

Note 9.—Dr. Falconer concluded by remarking that, in order to have a proper comparison, block should be contrasted with block, and *hâche* with *hâche*. (W. B. C.)

Note 10.—Mr. Prestwich admitted that he did not attach much importance to the presence or absence of films *taken by themselves*, but to the conditions which accompanied them. (W. B. C.)

Note 11.—Dr. Falconer held that there were two classes of evidence on the question of *hâches* : 1st. the intrinsic ; 2nd. the circumstantial. At the previous sitting, the intrinsic characters alone had been considered. If the conference, in conformity with the views of MM. Desnoyers and de Quatrefages, refused to attach weight to the intrinsic evidence, and rested entirely on the circumstantial, he doubted whether he should feel warranted in going further into the case ; he considered that observation on the *gisement* was liable to so many sources of fallacy and error, as not to be relied upon alone. (W. B. C.)

Note 12.—Mr. Busk considered that in the great majority of cases it was possible, by the intrinsic characters, to pronounce upon the authenticity or falsity of the *hâches;* but not in every case. (W. B. C.)

Note 13.—The discussion was then continued, not upon the general question, but upon the special one of the authenticity or otherwise of the Moulin-Quignon *hâches*. (W. B. C.)

Note 14.—Dr. Falconer added, that all these spurious-looking *hâches* presented a great sameness of character : they were of one or two types, as if made by one or two hands. Few or none were found in the *couche noire*, previously to the date of the asserted discovery of the jaw, but a great abundance since. It had been stated on good authority that more had been found at Moulin-Quignon within the last few months, than during several preceding years ; and the great mass of them were of the suspected character. (W. B. C.)

Note 15.—Besides the dendrites, the surfaces were deeply tinged with iron. (W. B. C.)

Note 16.—Mr. Busk remarked that *all* the larger pebbles found in the *couche noire* were tinged with iron, while *none* of the *hâches* were thus tinted. (W. B. C.)

Note 17.—Dr. Falconer observed that if the flints had been coloured anteriorly to their deposition, and then transported, some of them should be found free from colour. (W. B. C.)

Note 18.—Professor Williamson, F.R.S., at the request of Dr. Falconer, undertook to have made, in the laboratory of University College, a chemical analysis of the "black seam matrix," as it occurs in the deposit, and as it was presented on the bone.

The analysis was conducted with great care by his able assistant, Mr. C. Haughton Gill. The specimens submitted were as follow :—

1. A portion of the *couche noire*, or "black seam" matrix where in contact with the chalk, collected by Dr. Falconer on the 14th April, and having small portions of the chalk adherent.
2. Matrix of the black flint gravel occurring immediately above the thin layer of the "*couche noire*."
3. A portion of the black matrix enveloping the jaw, chiefly extracted from the mental foramen, and alveoli of the teeth.
4. A small portion of the black matrix extracted from the hollow tooth of the same jaw.

The results of Mr. Gill's analysis, communicated by Professor Williamson, are as follows :—

"The 'black seam' between the chalk and gravel (No. 1) was the only specimen, the quantity of which allowed of a separate qualitative examination. It contained the following constituents : Water, Silica, Iron, Alumina, Manganese, and Lime, with traces of Potash and Phosphoric Acid and Carbonic Acid in the following proportions :—

	Per cent.	Per cent.	Per cent.
Insoluble residue, consisting of Silica, Alumina, and a little Iron, determined in different portions of the specimen	38.36	45.00	55.30

	Per cent.	Per cent.
Iron and Alumina together, about half of each, the former as sesqui-oxide, but variable in different parts .	19.52	12.01

	Manganese (as Mn^3O^4.	Carbonate of Lime.
Mixed earth, taken from different parts of the specimen	11.0 per cent.	4.3 per cent.

"I have given the above various numbers to show how, nominally the same specimen may differ in different parts ; putting the last numbers in a table, we have :—

Constituents.	No. 1. Black Band between Gravel and Chalk.	No. 2. Black Matter in Gravel.	No. 3. Black Matter from Jaw.	No. 4. Brown Powder from Tooth.
Matter insoluble in Hydro-Chloric Acid . . .	55.30	56.31	62.37	53.41
Alumina and Oxide of Iron .	12.00	15.53	20.43	26.70
Oxide of Manganese (Mn^3O^4)	10.99	16.39	7.25	12.0
Carbonate of Lime . . .	4.30*	—	—	—
Loss of Weight by Heat (Aq.)	16.70	9.93	9.14	10.40
Phosphoric Acid, Potass, Loss, & undetermined Constituents	0.71	1.84	0.81	—
	100.00	100.00	100.0†	102.51‡

"I may remark that neither in the 'black gravel' matrix nor in the powder from the tooth or jaw was I able to find any lime.

C. HAUGHTON GILL."

In a note, dated 3rd June, 1863, addressed to Professor Williamson, forwarding the above results, Mr. Gill adds :—

"I must, however, first state that the result can only be considered very roughly approximate, as none of the specimens were of the same composition throughout, and of the substances removed from the cavities of the jaw and tooth the quantities were very small."

Note 19.—M. Desnoyers admitted the general similarity of the alleged fabrications, and their fresh look. (W. B. C.)

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* In all probability from minute adherent particles of chalk. (G. B.)

† Of this specimen there was only .186 gramme.

‡ The whole of the material at Mr. Gill's disposal was .125 gramme.

Note 20.—The precise nature of the white lamina produced by M. de Quatrefages was not satisfactorily determined. At first it was conjectured that it might be a flake of a tooth ; and when examined during the *séance* it was supposed to resemble a portion of a shell (?) But it remained unidentified when the conference broke up. (H. F.)

Note 21.—Mr. Busk showed that the surface of a newly fractured portion of that *hâche* which he had rubbed with a little moistened matrix on the point of his finger, presented exactly the same appearance as the general surface of the *hâche.* (W. B. C.)

Note 22.—This was the detached molar which had been placed in Dr. Falconer's hands at Abbeville, and which was sawn across (*i. e.* the fang) in London. It was covered with the matrix of the *couche noire,* exactly like the solitary tooth in the controverted jaw; and its section yielded the most remarkable freshness of character. But, on the objection raised by M. de Quatrefages, at the instance of M. de Perthes, this tooth was relinquished by the English members, as being open to uncertainty of identification, or error, through accidental misplacement in the box which bore the label referring to a detached molar found on the same day (28th March), in the same part of the *couche noire* as the jaw. (H. F.)

Note 23.—The jaw was produced towards the close of the meeting. M. de Quatrefages called attention specially to the state of the matrix. Mr. Busk thought it might have been artificially laid on, but would express no definite opinion until the jaw had been properly washed. M. de Quatrefages considered that it could be proved that no adhesive material, such as gum or gelatine, had been employed. M. Desnoyers remarked that the external surface of the *gangue* exhibited the granular appearance produced by a natural deposition of mineral matter, like '*limonite de fer.*' (W. B. C.)

MONDAY, 11TH MAY.

Note 24.—The *hâche* here referred to was No. 2 of M. de Quatrefages' series, which he had disengaged with his own hand *in situ,* and which Mr. Prestwich and Dr. Falconer had throughout regarded as not genuine. (H. F.)

Note 25.—M. Delafosse, Member of the Institute and Professor of Mineralogy, who saw the jaw for the first time and has taken no part in the discussion, considers that the matrix on the surface of the jaw has not been artificially laid on, but that it indicates that the bone has been imbedded in the matrix, and that this lodgment must have been prolonged. (W. B. C.)

Note 26.—The specimen above referred to (*Note* 24), No. 2, upon which M. Hébert gave an opinion.

Note 27.—This specimen was of the rudest possible form, and "had been given up at a previous meeting as factitious." (W. B. C.)

Note 28.—The specimen here referred to was procured by Dr. Falconer from the *couche noire* on the 14th April. In his view, confirmed by the opinion of Mr. Evans, who examined it, it bore the most pronounced characters of modern fabrication, by its rude form, deep conchoidal facets, high dividing angles, sharp uninjured edge, recent surface, absence of tinting, *patina,* or vitreous glimmer, and by the crushed fracture caused, apparently, by a vertical blow. In all these respects it was exactly like a counterfeit *hâche* of known English origin. One side was washed, and the matrix left intact upon the other. The granular appearance of "*limonite de fer*" in the matrix was such, that M. Delafosse saw no reason to think that it had been laid on artificially. (H. F.)

Messrs. Falconer, Prestwich, and Busk were not shaken in their opinion that the several specimens from Moulin-Quignon, Mautort, and St. Gilles, here referred to, were all modern fabrications, notwithstanding the verdict passed by so eminent an authority on the matrix, which was removed by washing with the utmost facility. They still regarded it as having been laid on artificially. (Mr. Busk remarked upon the St. Gilles specimen, "that the matrix contained unquestionable fragments of recent vegetable structure." W. B. C.)

Note 30.—Mr. Busk is now satisfied, from trials since made, that the *striæ* above referred to are not a character of decisive importance, as they can be produced at will when the *gangue* is soft and moist, simply by rubbing or wiping with a cloth, which may have been the case when the jaw was disengaged. (G. B.)

Note 31.—Dr. Carpenter agreed in the opinion expressed by Mr. Prestwich, that if the *striæ* insisted upon by Mr. Busk may have been produced artificially by a brush, they may also have been produced by friction in the gravel. (W. B. C.)

Note 32.—Mr. Busk ascertained subsequently that some of the moistened matrix which was accidentally brought in contact with the ivory handle of a penknife, produced after a few hours the same appearance of thin plates with metallic lustre, as those insisted upon by M. de Quatrefages. (Vide postea, *Note* 48.) (G. B.)

Note 33.—The "detached molar," which had been sawn in London was given up by the English members of the Conference at the previous *séance*, to meet the wishes of M. de Perthes, expressed by M. de Quatrefages. It was a strong part of the case upon which their opinions had been formed in London, and they were prepared to have sustained it. After having been withdrawn as a special point of evidence, it was again unexpectedly brought forward as the basis of a general argument on the abstract question of the value of the chemical and physical characters which commonly distinguish fossil from recent teeth. This molar, when sawn up, yielded all the characters of a recent tooth : the section was white, with glistening satiny lustre, full of gelatine, absolutely unadherent to the tongue, and perfectly free from mineral impregnation, although coated with a layer of mangano-ferruginous incrustation, derived from a stratum freely permeable to moisture. The enamel was white and brilliant. It was the combination of these positive and negative characters, viewed in connexion with the physical condition of the deposit, which led Dr. Falconer to pronounce it to be recent, in contradistinction to a fossil tooth. To that opinion he still adheres. Nothing was adduced at the Conference to shake it in the least degree. The instances brought forward as exceptions, were all more or less graduated illustrations of the *partial* retention of the recent characters in fossil teeth, without a precise statement of the conditions under which they were found, to explain the cause, while in the detached molar the recent characters were absolute, the fossil characters being at the same time wholly wanting. Mr. Tomes, F.R.S., whose knowledge in this walk of investigation, invests his opinion with authority, held the same view, as did also Mr. Busk. That the teeth of extinct mammals are in many instances preserved in cave-deposits, in a remarkably fresh condition, is well known, as are also the circumstances which contribute to the result. The same thing occasionally happens in quaternary deposits, where the stratum is impervious to water and thus favourable to the retention of gelatine. But is there a case on record, apart from the frozen soil of the arctic circle, where a tooth has lain for many thousand years, in an old quaternary gravel, imbedded in metallic oxides freely permeable to water, yet where it has eventually turned up absolutely unchanged, and fresh as a recent tooth ? Further, Dr. Falconer laid before the Conference several molars of *Rhinoceros tichorhinus*, procured by Mr. Nicholas Brady at Menchecourt from a bed of uncoloured sand, which were deeply infiltrated with metallic matter, and the ivory greatly altered. Fossil bones are admitted to be excessively rare at Moulin-Quignon (Antiquités Celtiques, tom. ii. p. 496). The only specimens seen by the Conference in M. de Perthes' collection were two or three small fragments of elephant's tusk, highly altered through loss of gelatine, coloured, and tinged internally with metallic patches. The fossil bones from all the deposits in the valley of the Somme are commonly much altered. The 'detached molar' stood out, exceptional in every respect. (H. F.)

Note 34.—The specimen here referred to by M. de Quatrefages, was the uncoloured fragment conjectured at one time to be part of a tooth, and then to be part of a shell, of which the precise nature was left undetermined. (Vide ante *Note* 20.)

Note 35.—Dr. Falconer remarked that of the two fossil specimens, from Anvers, put forward by M. Delesse, one of them, the canine, so far from being unaltered, adhered very strongly to the tongue, thus indicating that it had lost a very considerable portion of its gelatine, while the other, a sawn fang, although unadherent, was much altered in colour and had become yellow. He added (" that the conditions must be comparable to make the argument urged by M. Delesse of any "weight; and that he could not conceive the prolonged sojourn of a tooth in the "*couche noire* (the most ancient of the fluviatile gravels, according to Mr. Prestwich) without its being penetrated by iron or manganese infiltration." (W. B. C.)

Note 36.—The sections of teeth exhibited by Mr. Busk were:—1. Of two from skulls found in peaty deposits in Suffolk, and regarded by the Rev. Mr. Gunn as belonging to the ancient peat period; 2. Of a tooth from a skull of similar appearance found also in peat, in Northamptonshire; 3. From a skull dredged up from a depth of 20 feet in the bed of the Thames; 4. Of a tooth from the "coprolite jaw;" 5. Of one from a Gallo-Roman cranium from St. Acheul. All these crania, except the last, it is to be remarked, were of a deep brown or blackish colour, which pervaded the entire thickness of the bones.

In all, the *crusta petrosa* and dentine, were more or less deeply coloured; the colour corresponding with that of the skull to which the tooth belonged. In the dentine the colour appeared to proceed from the central or pulp cavity, and to diminish in depth towards the periphery. The *crusta petrosa* was in all more deeply tinted than the interior substance.

The object in exhibiting these specimens was to show that in teeth of a comparatively much more recent date than the quaternary period, and even in those belonging to the historical period, and found under a variety of circumstances, the dentine was coloured. It was thence deduced that the complete absence of any coloration in the dentine of the Moulin-Quignon tooth, notwithstanding the faint coloration of the *crusta petrosa*, might be assumed to indicate that it could not be of any very great antiquity. (G. B.)

Note 37.—The specimen referred to is a very remarkable lower jaw of a human subject, now belonging to Dr. Robert Collyer. It is reputed to have been found in the gravel-heap of a coprolite-pit near Ipswich. Although retaining a portion of its gelatine, it is infiltrated through and through with iron. The Haversian Canals are filled with red oxide, and a section of the fang shows that the ivory is partly infiltrated with the same metal. This specimen proves that a human jaw, if favourably placed, is equally susceptible of impregnation with metallic matter, as the bone of any other mammal. The 'detached molar,' and the 'human jaw' were reputed to have been found so situated in the 'black seam,' yet they were exhumed entirely free from infiltration. Mr. Busk has subsequently ascertained that a part of a human pelvis in the collection of M. de Perthes, and other bones belonging to two bodies probably interred (as supposed by Mr. Prestwich, and Mr. Evans) in the gravel below the *loess* near Mesnières, during the early part of the Celtic period, were all more or less marked with dendrites. (H. F. & G. B.)

Note 38.—The metallic patches here referred to by M. Desnoyers were universally recognized, but they washed off readily under the use of a brush; and Mr. Busk accidentally found that a very similar appearance was presented by minute particles of the argillaceo-metallic black matter on the "*couche noire*" adherent to the surface of polished ivory. (Vide postea, *Note* 48). (G. B.)

Note 39.—The characters yielded by the jaw, when sawn across and washed, were as follow:—The section was so conducted as to include a portion of one of the fangs of the solitary tooth. The black coating was washed off readily by means of a sponge, and the residuary spots in the minute hollows were removed by the aid of a tooth-brush. The general colour of the washed surface was a light buff, mottled with brown stains. The outer surface was tolerably smooth, presenting little indication of the superficial erosion commonly seen in old buried bones. There was no appearance of dendritic deposit either on the exterior or within, and no infiltration of metallic matter. The substance of the bone was dry and friable, especially towards the alveolar border, but, on the whole, it was tolerably firm under the saw, and the fresh section afforded a distinct odour of sawn bone. The internal cancellated structure was of a faint brownish tinge, and the cells free from any incrustation. The most remarkable appearance observable in the section was the lining of the dental canal with a thin layer of fine gray sand, free from admixture with the black metallic matrix which blocked up the orifice of the canal below the condyle. The section of the fang showed that the dentine, so far as exposed, was white, and in no respect different from that of a recent tooth. The enamel was white and brilliant. The socket towards the upper part was not completely filled by the fang, and the interval was partially occupied by black matrix and sandy particles. The Conference was too pressed for time to wait for a chymical analysis. The general results may be epitomised thus :—

1. The bone was free from mineral impregnation, and but little altered otherwise 2. The matrix was washed off with facility, leaving a clean, mottled, and but slightly eroded surface. 3. The black coating or matrix had not penetrated deeply into the dental canal, which was lined by a layer of grey sand that looked as if it were the result of a previous lodgment of the bone in a non-ferruginous sandy bed. 4. The section of the fang of the molar yielded all the characters of freshness which had been previously observed in the " detached molar."

The opinion expressed by Mr. Busk upon the first inspection of the divided jaw, was that " the bone is of considerable but not of very high antiquity, and that it presents no character which may not be found in cemetery bones." It is to be remarked also that its condition was quite different from that of the fossil bones of the quaternary sands and gravels in the valley of the Somme, which, whether from the white sandy beds of Menchecourt, or the ferruginous gravels at St. Acheul, are all commonly covered and pervaded throughout their substance by dendritic deposits.

The observation with respect to the resemblance between the washed surface of the jaw and that of a Gallo-Roman jaw from St. Acheul, was applied, not to the colour, which was very different, but to the degree of erosion which it had undergone. In this respect, if there were any difference, the erosion appeared to be less in the Moulin-Quignon jaw than in the other. (G. B.)

Note. 40.—The party here named reached Abbeville about midday, and were present at the operations on the ground, after 2 p.m.

Note 41.—The adjournment of the Conference to Abbeville, suggested by the President, was not contemplated in the original *programme* forwarded from London. The proposal was doubtless judicious, from the important share which the evidence as to the nature of the beds, whether disturbed or undisturbed, must necessarily have had in determining the final conclusions. But considering the opinions held by some of the members as to the very significant nature of the intrinsic evidence, respecting the modern character of the *hâches,* and the non-fossil condition of the jaw, as set forth in the preceding *procès verbaux,* time and caution were demanded in order to carry it out properly, and guard against errors of observation or hasty judgment, on the conditions under which *hâches* or other objects might present themselves in the section. The sources of fallacy and grounds of suspicion were numerous. Operations on the gravel-pit hurried through a single day, under a multiplicity of observers, amidst many distractions and much excitement, were hardly consistent with the close, severe and repeated scrutiny which the critical importance of the case required. Yet the operations thus carried out formed the basis upon which the final conclusions were in a great measure founded. (H. F. and G. B.)

Note 42.—The opinion here expressed is an assumption which has not been sustained by subsequent observation. After the close of the Conference Mr. Evans visited Abbeville, and ascertained by experiment that a horizontal hole might be dug into the face of the gravel section at Moulin-Quignon, and afterwards plugged up in such a manner as not to be discernible except under the closest examination. This statement is made with the sanction of Mr. Evans.

Note 43.—The sand here referred to was not compared under the microscope with that lining the arterial canal of the jaw: the correspondence of the two, further than that they were both grey sands, was not established by actual observation but assumed. The sand contained in the canal was carefully examined under the microscope by several members of the Conference at their previous meeting.

Note 44.—The opinion expressed by Mr. Busk was not exactly that set forth in the "*procés verbal ;*" but that " the coloration of the flints of the gravel of the 'black seam' must have taken place anteriorly to the lodgment of the bone among them, otherwise the bone would have been equally stained." (G. B.)

Note 45.—The five *hâches* here referred to were submitted to the Conference at midnight and washed, but not thoroughly. At the time, for obvious reasons, it was difficult to examine them critically. Four were liberally handed over by the President to Mr. Prestwich, the fifth being retained in France. The first four were carefully examined by Dr. Falconer after his return to London. The following are descriptive notes on each:

No. 1.—Labelled "Vue prendre en *situ*, A. Edwards;"—contour, narrow ovato-lanceolate, or of the lance-shaped pattern, sharp all round the edge; body thick, facets very irregular, and deeply conchoidal; like those which Mr. Evans and Dr. Falconer consider to be modern imitations; ridges separating the facets high and angular; surface where washed untinted like that of a recent flint; no *patina* or incrustation, no dendrites, nor glimmer from rolling; thin films of considerable extent without fractured margins.—Suspected to be modern.

No. 2.—Washed on one side, covered with ochreous sandy matrix on the other; form ovate, point broken off and rounded; body thin, facets shallow, ridges low or abraded; surface discoloured and iron-tinted, with a bright glimmer; margin all round more or less obtuse or abraded.—Of the undoubted authentic type.

No. 3.—Ovate in outline like the last, but point entire, substance mottled with light grey patches; in all respects, as regards facets, fractures, ridges, edges, fresh surface, absence of weathering, stain or patina and in matrix, like No. 1. —Suspected to be modern.

No. 4.—Pointed ovate in contour; substance variegated with round whitish patches; in surface, fractures, edges, and absence of tinting, fresh aspect like No. 3. Facets excessively rude and conchoidal; dividing ridges high and angular; upon the thick part of the body on one side, a rude irregular pit with shivered fracture as if caused by a vertical blow: some of the films very large, quite entire, and no indication of matrix below them.—Suspected to be modern.

The Fifth remained unwashed when the Conference closed. But, so far as a judgment could be founded upon it without removing the matrix, it presented the characters shown by the three, above described, suspected to be modern. The result of this examination and judgment, upon the whole being: one undoubtedly genuine; three suspected; and one undetermined. (H. F.)

Note 46.—Authentic, in so far as they were found *in situ*, under the eyes of the Conference, without any fact having been observed or detected to support the suspicion that they had been fraudulently introduced; but not necessarily so in the sense of being proved to be genuine, in spite of the intrinsic evidence to the contrary. Dr. Falconer, at the final meeting, withheld his assent to the third conclusion, that "the majority if not the whole of the *hâches* found in the lower portions of the gravel-pit of Moulin-Quignon, about the same time as the jaw, are genuine."

Note 47.—The English members expressed a wish to have an opportunity of deliberately comparing the *hâches* last found, with those submitted to the Conference at Paris before coming to a final conclusion; but the proposal was overruled.

Note 48.—Although M. de Quatrefages was unable to perceive any resemblance between the spots formed by the black "*gangue*" upon the ivory handle of the penknife, and those on the 'jaw,' several other members of the Conference freely admitted a certain similarity between them, inasmuch as in both cases the specks were distinguished by a metallic lustre.

The accidental observation, however, of the adhesion of these particles to the smooth polished surface of the ivory, proved that it was unnecessary to suppose, as had been suggested at one of the meetings in Paris, that any glutinant material was required to cause the close and firm adhesion of the "*gangue*" to the surface of an object. Subsequent experiments with the black "*gangue*" have fully shown that when applied in its soft or natural condition to any surface, however smooth, and apparently of any solid substance, this material, when dry, adheres with the greatest tenacity. So far, therefore, the mere adhesion of the "*gangue*" to the jaw might be explained; and some further justification perhaps was afforded of the supposition broached at Paris by Mr. Busk and others, that the "*gangue*" *might* have been artificially applied to the bone. In a short article in the "Abbevillois" newspaper of the 15th May, it was stated that the "experiment," as it was termed, with the penknife handle was intended to prove that the "*gangue*" contained no staining or corrosive element; but this is a complete mistake. (G. B.)

Note 49.—The previous sitting lasted from about 7 p.m. of the 12th to 2 a.m. of the 13th. The final *séance* commenced after 9 a m. and terminated at 10·30 a.m. of the 13th. The resolutions which were adopted, were, under pressure for time caused by the imminent immediate departure of some of the members, put orally from the chair, without having been deliberately weighed by the members of the Conference beforehand. (H. F. and G. B.)

Note 50.—The first resolution implied that the jaw had not been fraudulently introduced, and that it was in the deposit before M. de Perthes extracted it on the 28th March. About the second clause there was never any question, and about the first, no evidence was brought to light during the operations of the day, to support the suspicion previously entertained by the English members. The workmen were therefore absolved from the imputation, in default of proof. But the resolution did not involve the admission that the jaw was held to be of fossil antiquity, the physical characters pointing to an opposite conclusion; the memoranda handed in by Dr. Falconer and Mr. Busk distinctly embodied this reservation on their part. (H. F. and G. B.)

Note 51.—The second resolution involved the admission that the jaw was of the same age as the Moulin-Quignon gravels, respecting which the most opposite opinions are entertained: Mr. Prestwich regarding them as being of the "high level" series, or most ancient of the quaternary deposits of the Somme valley; while M. Elie de Beaumont refers them to his "*dépôts meubles sur des pentes,*" as superficial modern deposits of the age of the peat beds. Dr. Falconer and Mr. Busk withheld their assent to this resolution. (H. F. & G. B.)

Note 52.—The third resolution involved the admission that the numerous *hâches* from the "*black seam*" of Moulin-Quignon, which, upon the intrinsic evidence, had been uniformly held to be *spurious* by three of the members during the first three sittings of the Conference, were for the most part, if not all, *genuine*. Dr. Falconer withheld his assent to it, still believing them to be questionable. (H. F.)

Note 53.—The fourth resolution, regarded *per se*, was indefinite. It implied the admission that the *hâches* and the jaw were of the same age, whatever that age, or the age of either might be. If the view of Mr. Prestwich were adopted, they were both of the old quaternary period; in the view of M. Elie de Beaumont they would both be as modern as the Gallo-Roman period; and in the view of M. Hébert, they would be of an age between the two. Dr. Falconer and Mr. Busk withheld their assent to the resolution. (G. B. and H. F.)

Mr. Busk's memorandum, as drafted in English, was as follows:—

"Abbeville, May 13, 1863.

"Mr. Busk desires to add, that although he is of opinion, judging from the *external* condition of the jaw, and from other considerations of a more circumstantial nature, that there is no longer reason to doubt that the jaw was found in the situation and under the conditions reported by M. Boucher de Perthes, nevertheless it appears to him that the *internal* condition of the bone is wholly irreconcileable with an antiquity equal to that assigned to the deposits in which it was found."

Both Mr. Busk and Dr. Falconer admitted that the 'finding of the jaw' under the conditions reported by M. de Perthes, was authentic; but they refused to accept the antiquity of the jaw in the sense of its being a quaternary fossil remain. (G. B. and H. F.)

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Miscellanea.

On the Existence of Two Forms, and on their Reciprocal Sexual Relation, in several Species of the Genus *Linum*. By Charles Darwin, M.A., &c. Journ. Linn. Soc.—Bot. vii. 69.

Following up his important discovery of the remarkable sexual relations subsisting between forms of the so-called hermaphrodite flowers of *Primula* and the Orchidaceæ, Mr. Darwin has been oberving three or four species of *Linum* (Flax). His principal results we briefly lay before our readers.

The large-flowered Crimson Flax occurs, like the Primrose, under two forms, which differ only in the pistil. No difference can be detected in the pollen. In one form the styles and stigmas together are about half as long as the pistil of the other form. In that with the short pistil, the five stigmas diverge, so as to pass between the surrounding and alternating stamens, and thus project into the tube formed by the bases of the petals. In the other form the styles are nearly upright.

Mr. Darwin finds that the stigmas of each form are almost quite powerless on pollen from stamens of the same form, while the pollen-grains of the opposite form emit their tubes freely in a few hours, "the two pollens and the two stigmas mutually recognising each "other." And with regard to fertility, he says that "it is no exagge-"ration to say that the pollen of the long-styled *Linum grandiflorum* "(and conversely of the other form) has been differentiated, with "respect to the stigmas of all the flowers of the same form, to a "degree corresponding with that of distinct species of the same "genus, or even of species of distinct genera." The experiments upon which these conclusions are based are described in detail, and wholly substantiate what is stated.

In *Linum perenne,* besides a short and long pistil, the stamens of the long-styled are "hardly more than half the length of those of "the short-styled," the stigmas of the former "turn round so as "to face the circumference of the flower" about the time that it expands. In this species also Mr. Darwin finds abundant evidence to prove "that the stigmas of each form require pollen from the "stamens of corresponding height produced by the opposite form." The object gained by the divergence of the stigmas of the short-styled *Linum grandiflorum,* is sufficiently manifest, since the nectar secreted by the flower, and which serves to attract insect visitors, is formed at the base and outside of the stamens. This necessitates the insertion of the proboscis of the insect between the petals and stamens, and insures a supply of foreign pollen upon the upturned projecting stigmas. In *L. perenne* we have stated that the stamens are of two lengths, thus "the pollen will adhere to different parts "of an insect's body, and will generally be brushed off by the stigmas "of corresponding height, to which stigmas each kind of pollen is "adapted." Two other important points are referred to, incidentally, by Mr. Darwin. "Botanists," he says, "in speaking of the ferti-"lization of plants, or of the production of hybrids, often refer to "the wind or to insects as if the alternative were indifferent. This "view, according to my experience, is entirely erroneous. When the "wind is the agent in carrying pollen, either from one separated sex "to the other, or from hermaphrodite to hermaphrodite (which latter "case seems to be almost equally important for the ultimate welfare "of the species, though occurring perhaps only at long intervals of "time), we can recognize structure as manifestly adapted to the ac-"tion of the wind as to that of insects when they are the carriers. "We see adaptation to the wind in the incoherence of the pollen, in "the inordinate quantity produced (as in the Coniferæ, Spinage, &c.), "in the dangling anthers well fitted to shake out the pollen, in the "absence or small size of the perianth, or in the protrusion of the "stigmas at the period of fertilization, in the flowers being produced "before they are hidden by the leaves, in the stigmas being downy "or plumose (as in the Gramineæ, Docks, and other plants) so as to "secure the chance-blown grains. In plants which are fertilized by "the wind, the flowers do not secrete nectar, their pollen is too inco-"herent to be easily collected by insects, they have not bright-

"coloured corollas to serve as guides, and they are not, as far as I "have seen, visited by insects. When insects are the agents of fertilization (and this is incomparably the more frequent case both "with plants having separated sexes and with hermaphrodites), "the wind plays no part, but we see an endless number of adaptations to ensure the safe transport of the pollen by the living "workers."

The other point refers to the fertilization of flowers in the bud. Mr. Darwin does not deny that such may take place. He says he has "reason to believe that some flowers are frequently fertilized "without expanding;" but his observations lead him "to disbelieve "that this is ever the invariable course with all the flowers of any "species whatever." He concludes, "Although good is gained by "the inevitable crossing of the dimorphic flowers, yet numerous "other analogous facts lead me to conclude that some other quite "unknown law of nature is here dimly indicated to us."

PHILIPPI ON THE METAMORPHOSES OF PTEROMALUS.

In the Annales des Sciences Naturelles, for 1851 (3rd Ser. V. xv.) Dr. Ph. de Philippi has given a very interesting account of the development of a small parasitic Hymenopterous insect belonging to the genus *Pteromalus.* This minute insect lays its eggs singly in the eggs of a beetle (*Rhynchites betuleti*), which appear to be often so transparent, that the development of the Pteromalus-larva can be seen within them. Dr. Philippi found to his surprise that the animal hatched from the egg of the Pteromalus was "un très petit "animalcule, qu'on dirait un Infusoire muni d'une queue qu'il secoue "brusquement comme un fouet, mais qui, par sa forme et les poils "qui hérissent son corps, ressemble à certaines lèvres de Diptères." Soon this curious larva lost its activity, and within it was developed a second larva, which after a while changed into a nymph. Dr. Philippi having satisfied himself that this was not a case of double parasitism, but that the first larva was really a stage in the development of the Pteromalus, came to the conclusion that it was the "Générateur de la larve du Ptéromalien, c'est, d'après le mot adopté, suivant l'exemple de M. Steenstrup, une *nourrice* . . . . . Quoi qu'il en soit, cet insecte nous offre le seul exemple connu, jusqu' à présent dans cette classe, d'une véritable generation par *nourrices*, ou, comme j'aimerais mieux l'appeler, empruntant une phrase du langage politique, d'une *generation à deux degrés.*" Dr. Philippi now confirms (Note Zoologiche estratti dall' Archivio per la Zöologia, Anatomia, e Fisiologia, mese di Giugno, 1862?) his previous observations in most particulars, but regards it not as a case of metagenesis, but of hypermetamorphosis. In other words he considers that the first larva passes into the second by a change of skin, as in *Sitaris*, *Meloë*, and other insects, and we think that most naturalists will be disposed to acquiesce in this rectification. J. L.

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Reviews.

XLVIII.—Contributions to the Natural History of the United States of North America. By Louis Agassiz. Vol. IV. Boston, 1862.

(*Continued from page* 359.)

The fourth part of Professor Agassiz' 'Second Monograph,' is entirely devoted to the extensive order of Hydroidæ, which, as we have shown, in his arrangement, includes—

1. The *Hydroida* of Johnston and others.
2. The Tabulate, Tubulose and Rugose Corals; and,
3. The *Siphonophora.*

In the chapters which treat of the Hydroid Zoöphytes, usually so called, various forms are described belonging to the groups *Tubularina* and *Sertularina* of Ehrenberg, together with their proper allies, the *Cryptocarpæ.*[*]

Of *Tubularina*, or *Corynidæ*, Professor Agassiz notices not less than twelve genera. Most of these are already known, but the species here elucidated appear, with some few exceptions, to be representatives of those which occur on the eastern shores of the North Atlantic. They are as follows:—

a. Coryne mirabilis.
b. Clava leptostyla.
c. Rhizogeton fusiformis.
d. Hydractinia polyclina.
e. Halocharis spiralis.
f. Hybocodon prolifer.
g. Parypha crocea.
h. Tubularia Couthouyi.

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[*] See Natural History Review, 1863, p. 352.

i. *Thamnocnidia spectabilis.*
j. *Thamnocnidia tenella.*
k. *Corymorpha pendula.*
l. *Pennaria gibbosa.*
m. *Eudendrium dispar.*
n. *Bougainvillea superciliaris.*

a.—*Coryne mirabilis* is very like one of our own British forms of this genus; we fear to say which, lest by so doing we should provoke the criticism of some over discriminative Zoöphytologist. In a note on a future page of his father's monograph, Mr. Alexander Agassiz describes the medusoid of a second species, *C. rosaria,* from the Gulf of Georgia, which "resembles the English *C. pusilla* very closely." In fact, *Sarsia tubulosa* (the medusiform zoöid of *C. pusilla*), is scarcely, if at all, to be distinguished from the free gonophores of either of the two American species. Professor Agassiz enters with great minuteness into the general structure and histology of this Hydroid, giving ample details as to its modes of budding, with special reference to the formation of its reproductive zoöids.

b.—*Clava leptostyla* is a minute zoöphyte, somewhat akin to *C. multicornis.* Dwelling in colonies on *Fucus vesiculosus,* its mode of life differs much from that of the other American Hydroids, for it alone, "though much less protected by a natural covering than several of the Tubularians, is subjected to the dashing of the breaking surf." It is also more active. "From the mouth at the tip of the head, to the attachment of the slender base of the stem, the whole upright body is highly contractile, and capable of assuming a variety of shapes. When very lively it is stretched to the utmost, with elongated head, and extremely attenuated tentacles; at other times, every thing remaining as in the first instance, the head is depressed to a flat-topped disk, from which the tentacles radiate nearly in one plane, like the spokes of a wheel." In the beautiful drawing by Clark and Sonrel which illustrates this portion of the text, these two diverse aspects of the tentacular crown are represented in a highly characteristic manner.

c.—The next species, *Rhizogeton fusiformis,* belongs to a new genus, of which only male colonies have hitherto been noticed. *Rhizogeton* is, in some degree, intermediate between *Clava* and *Hydractinia;* but is readily discriminated from the former by the position of its reproductive buds, which arise from the creeping base and not from the bodies of the polypites. These buds, 'medusæ' or 'medusa-buds' of Professor Agassiz, were fixed. "In other genera (he writes) we have been accustomed to see the medusa wither and decompose, after it had matured and discharged its reproductive contents; but here an unusual and unexpected phenomenon takes place; *one and the same individual medusa, after discharging its reproductive organs, is metamorphozed into a hydra;* the same wall which formed the disk of the medusa grows upward, and forms a long, cylindrical body, within which an inner wall develops, from the base of the still persistent proboscis, and completely lines the outer wall. We have traced this metamorphosis up to the time when the head of the hydra had begun to form, and its tentacles were just far enough advanced to give it a knotted appearance, but unfortunately the specimens died, and we have not been able to investigate the matter any further." May it not be that there is some error here, or has Professor Agassiz mistaken for medusa-buds, the bodies termed 'proliferous polypes' (or stalks), by Allman, and by Huxley 'gonoblastidia?' The curious intermediate forms which connect these gonoblastidia with true digestive zoöids, are now, at length, beginning to be known. But we much need a more detailed history of *Rhizogeton*, and a careful comparison of its characters at once with those of *Dicoryne* and *Hydractinia.*

d.—In *Hydractinia polyclina*, we have a new species of this, perhaps, the most complex of the Hydroids proper. Like the European *H. echinata*, it grows "upon the shells of Gasteropods, which served for the retreat of Hermit crabs;" but it also assumes a non-parasitic habit, for, "subsequently, it has been discovered and collected in great abundance from rocks in tide-pools. In these latter habitats, it often covers several square feet with a rosy, velvet-like carpet, presenting a delicacy and vividness of tint which can hardly be described. The fact that it is often left by the tide, for five or six hours, in pools containing not more than a pailful of water, is enough to negative the assertion that the movable homes of Hermit-crabs are necessary to the welfare of the colonies of Hydractinia which settle upon them." The 'Ophidian or Spiral Polypes' of Dr. Strethill Wright,* are stated by Professor Agassiz to be but modified forms of the 'fertile Hydroids' (gonoblastidia), though he has not seen reproductive bodies upon them. Neither has he recognized the long isolated tentacles (*Tentacular Polyps*), first described by the observer just mentioned; organs which appear to us homologous with the tentacles of *Physalia, Velella* and *Porpita*, arising from a laterally expanded cœnosarc, and having no immediate connection with the bodies of the polypites. Reproductive buds sessile on the common base of the colony, as distinguished from those which are borne by the gonoblastidia, were not observed. Some of the ophidian zoöids were branched. The 'sterile Hydroids' (polypites) of the male and female colonies differed; the former having a much longer proboscis.

e.—The new genus, *Halocharis*, is afterwards shown by Professor Agassiz to be identical with the previously described *Corynitis* of McCrady, a simple Hydroid, having a slender, naked, nearly cylindrical body, along which, in spiral order, are disposed the tentacles. These are "successively larger as we follow the stem upwards. The upper part sometimes becomes swollen to such an extent as to give the body a club-shaped outline, and in this state it reminds one of Coryne. Having no horny sheath, it can contract, from top to bottom, so as to become a short, almost globular mass, with several transverse folds overlying each other, and extending from the base at least half way up the stem. When the tentacles are contracted, also, the whole body resembles a warty excrescence." The reproductive bodies are unknown.

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* *On Hydractinia echinata.*—Edinburgh New Philosophical Journal, April, 1857.

f.—j.—Hybocodon, Parypha and *Thamnocnidia* are merely subdivisions of *Tubularia*, from which Professor Agassiz has here, for the first time, separated them. "The genera differ from one another, chiefly by the form and arrangement of the tentacles of the proboscis, and the structure of the medusæ-buds." The distinctions on which Professor Agassiz here insists do not, when compared with his figures, appear to us to be of generic rank. Of the British species, *T. indivisa* remains in *Tubularia* proper; *T. coronata* and *T. calamaris* are referred to *Thamnocnidia*, while a new genus, *Ectopleura*, is constituted for *T. Dumortieri*.

Hybocodon prolifer produces free reproductive zoöids, closely resembling the *Euphysa* and *Steenstrupia* of Forbes, and the medusoids described by Steenstrup as budded from his *Coryne fritillaria*. The proboscis of the hydroid form is furnished, in adult specimens, with thirty-two tentacles, arranged in two rows, those of the upper or distal circlet, closely surrounding the mouth, being only half as long as those of the second circlet, situate a short distance below it; "and the decurrent bases of the latter alone form the broad, parallel ridges, which lie closely, side by side, about the circumference of the proboscis." The tentacles of the two rows alternate, but are occasionally thrown together so as almost to constitute a single series.

Parypha crocea has twenty-four buccal tentacles placed in a single row. "They are cylindrical, and tapering from the base to the tip, which is rounded off in an oblique manner. At their bases they touch each other, and thence are decurrent, in juxtaposed broad ridges, which give the proboscis a longitudinally ribbed appearance. The upper side of the bases of these tentacles project in approximated ridges to the very edge of the mouth, just in the same manner as obtains in *Thamnocnidia spectabilis* and *T. tenella*." Between the hydroids of these three species there scarcely exists any difference, and in all the medusoids remain attached. Those of *Parypha crocea* present an extremely simple structure, without any traces of a canal system, and the females only possess tentacles. In the medusoids of *Thamnocnidia*, "around the lower edge of the disk, are three or four solid, short, and rather unshapely tentacles." *T. tenella*, the smallest of the American Tubularians, differs from *T. spectabilis* merely in size, habit, and mode of branching.

Tubularia Couthouyi is a close ally of the well known *T. indivisa*. As in that species, the reproductive bodies are fixed. The buccal tentacles of the hydroid are about fifty in number, and "are disposed in three or four indistinctly defined series. In each series they are successively shorter than the next inner, or higher ones, and the outermost are mere papillæ."

Of the five species of true Tubularians just mentioned, three are always found in the brackish water of harbours. Two only, *Hybocodon prolifer* and *Thamnocnidia tenella* choose for their habitat clear open rock-pools.

k.—The genus *Corymorpha* is of special interest to the zoöphytologist. It is one of the many strange forms described for the first time in the classic 'Beskrivelser' of Sars, and also one of the first Hydroids in which the phenomenon of 'alternate generation' was observed. Its typical species, *C. nutans*, rediscovered by Forbes and Goodsir in the British Seas, excels all other simple Hydroids in size, and perhaps in beauty. Quite recently its structure and reproduction have been very carefully investigated by Allman,* and Sars himself † has just given us an essay in which no less than seven species of *Corymorpha* are described.

To these Professor Agassiz has added another, *C. pendula*, which closely approaches the *C. glacialis* of Sars, resembling this also in the fixed character of its medusoids. Male specimens only were observed, and the details of the structure of these are by no means complete. Curiously enough, Professor Agassiz recognizes but two species of *Corymorpha*, his own and *C. nutans;* ignoring, without any comment, the other species admitted by Sars.

l.—Cavolini, in his famous work, gave a figure and description of a supposed Sestularian, *S. pennaria*, for which Goldfuss afterwards constituted a separate genus. The name *Pennaria* is certainly appropriate, this zoöphyte exhibiting a shaft-like tapering stem, from the scarcely perceptible zig-zag bends of which arise, on either side, rows of alternating branches, bearing the polypites. *Pennaria*, however, is chiefly interesting because of its zoölogical position, since it seems to connect together the two principal sections of the Corynoid group,‡ represented by the genera *Tubularia* and *Coryne*, respectively. As in the former each polypite possesses a single circlet of long *proximal* tentacles, but these are not, like those of *Tubularia*, set round the margin of a well-marked disk. On the other hand the distal region of the polypite is largely developed, forming a conspicuous probocis, the oral end of which is "covered by numerous short, globe-tipped tentacles." The medusoids, which are few in number, arise independently of one another, each upon a short stalk, immediately within the proximal tentacular circlet. "What seemed to distinguish this medusa [in *P. gibbosa*] from all other Medusæ, among the Tubularians, was the position of the ovaries, which, instead of being on the proboscis, were near the peripheric, or outer end, of the chymiferous tubes; these organs were, however, not so far developed as to show their sexual character, and may be only specialized cells, as in Zanolea." Professor Agassiz seems to forget the parallel case afforded by *Campanularia Löveni* in the allied order of *Sertularida.* In this form, according to Allman's observations,[*] the generative elements are situate precisely as in the *Corynidæ*, while in all other Sertularians, and, consequently, in all other species of the genus *Campanularia* itself, they arise along the course of the radiating canals.—We would refer to the description and figures of *Pennaria* here given for a further account (the best indeed hitherto published) of this singular genus. Professor Agassiz likewise informs us "that the Hydroids described by Ayres and Leidy, under the names of *Globiceps* and *Eucoryne*, and by McCrady, under the name of *Pennaria*, are very closely allied, but not generically identical with *Pennaria*, though belonging to the same family."

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* *Notes on the Hydroida*, A. N. H. January, 1863.

† 'Ueber das Ammengeschlecht Corymorpha und seine Arten, nebst den von diesen aufgeammten Medusen', Wiegm. Arch. 1860, p. 347 [translated in A. N. H. Nov. 1861].

‡ Corynidæ of Huxley, Tubularina of Ehrenberg and Johnston.

m. n.—*Eudendrium dispar* and *Bougainvillea superciliaris* chiefly differ from one another in the fact that the polypite of the former presents a long flexible proboscis, while in the latter the proboscis "is very short, forming a mere conical papilla." In *Eudendrium* the reproductive zoöids are fixed, in *Bougainvillea* they detach themselves. We are disposed to think that the *Bougainvillea* here described belongs to the genus *Perigonymus* of Sars.[†] The name *Bougainvillea* (or *Hippocrene* its synonym) had indeed long been applied to the medusoids of Tubularian zoophytes allied to *Eudendrium*, while as yet their relation to the hydroid stock whence they were budded remained unknown.

Before proceeding to notice the Sertularians of the American coast, Professor Agassiz, within the short compass of five pages, enters upon the consideration of what is undoubtedly the most novel and remarkable portion of his monograph. We refer, of course, to his proposal to place the *Corallaria tabulata*, and, from analogy, the *rugosa* also, among the Hydroids. And to this step he has been led by original observations on the living animal of *Millepora alcicornis*, We quote the following paragraph, having immediate reference to the problem under discussion:—

> "The opportunity I had while in Florida of observing Millepora alive, has satisfied me, however, that this genus has none of the characteristic features of the true Polyps, the main cavity of the body not being divided by vertical radiating partitions into chambers, as is the case in all the members of this class. Like the true Hydroids each individual has a simple, undivided cavity, with double walls. The individual Hydræ resemble very strikingly those of Halocharis, and, to some extent also, those of Coryne, and even those of the fertile Hydractinia. As in these genera, the mouth opens at the summit of the head, as a simple, round aperture, alternately opening and closing; the digestive cavity being a simple straight cylinder when empty, and widening somewhat when full. The outer wall is much thinner than the inner wall, which consists of large cells, stretching across the whole thick-

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[*] *Notes on the Hydroid Zoophytes*, A. N. H. August, 1859.

[†] See Allman in A. N. H. January, 1863, p. 10.

ness of the wall. There are two kinds of hydræ in one and the same community; the large ones, with very few, and generally only four or five, and seldom six, short tentacles, around the head, terminating in a more or less spheroidal knob, supported by a short peduncle, are fewer in number; the smaller ones are much more numerous, and more active. The latter differ chiefly from the larger hydræ, in having tentacles scattered upon the whole length of the stem, like Halocharis; but instead of being gradually larger from base to summit, the reverse is the case with the tentacles of the small hydræ of Millepora, the lower ones being the larger, and those near the summit growing gradually smaller and smaller. The knobs of all these tentacles are chiefly made up of larger lasso-cells, the largest of which have a very long thread, remarkable for the enlargement of its spiral band, at a great distance from the bulb."

Organs of reproduction were not discovered. If these be external, and if *Millepora* want a proper gastric sac, then this genus must undoubtedly be placed apart from the *Actinozoa,* though whether with the Hydroids or not may be looked upon as an open question. It will also be disputed whether the analogy should be extended to all the other *Tabulata.* Some there are who may feel disposed to ask, whether the soft structures seen by Professor Agassiz on the skeleton of *Millepora* were not, in reality, parasitic forms, and, before assenting to the wholesale alteration in our systems which he demands, crave for some repetition of his observations. Scepticism, in science, is often not only allowable, but desirable; and a man of science so eminent as Professor Agassiz would be one of the first to acknowledge the liability of all, even of the best, observers to error.

In further corroboration of his views, Professor Agassiz goes on to describe the skeleton of *Millepora alcicornis*, *Pocillopora damicornis*, and *Seriatopora subulata*, from the "peculiar characteristics" of which latter genus he infers, "that the Corallaria rugosa of Milne-Edwards are more likely to have been Hydroids than true Polyps."

"At the very earliest stages of growth recognizable on the corallum, the young cell possesses a columellar projection, such as is so prominent in the older cells. Originally, then, these young cells have the form of inverted, truncated cones, which finally deepen and become parallel sided, but as they do this the central columella rises, and at the same time, usually, four perpendicular partitions, at ninety degrees from each other, are thrown out from the axis to the periphery, in such a way as to produce four cavities around the axis. After the cell has attained a depth usually equal to its breadth, a transverse diaphagmic partition is developed, and then another chamber, or rather a fourfold cavity is formed, to be eventually partitioned off like the preceding one, and so on until the end of the existence of the hydra."

These observations are, at least, useful in showing the necessity of examining fresh examples of corals in different stages of growth. For their hard parts are much more delicate than, at first sight, would appear, and require, therefore, careful manipulation. "It is seldom that in dried specimens of the corallum [of *Millepora alcicornis*] the natural smooth surface can be studied with confidence, on account of the extreme delicacy of the spongiform mass of most recent growth. It is impossible, even with the utmost care, to handle a specimen without abrading the slender, irregular spicula, whose points form the horizon over which the soft walls of the animal stretch in a uniform, smooth film. It is, therefore, necessary to study perfectly fresh specimens, in order to form a correct idea of the relations of the superficial, spiculate deposits of the animal basis."

Of Hydroids referable to the very natural division of *Sertularina*, Professor Agassiz figures and describes the following eight species—

a. *Clytia poterium.*
b. *Clytia bicophora.*
c. *Clytia intermedia.*
d. *Clytia cylindrica.*
e. *Laomedea amphora.*
f. *Obelia commissuralis.*
g. *Eucope diaphana.*
h. *Dynamena pumila.*

All of these, excepting the last (*h*), belong to that section of *Sertularina* in which the polypites are stalked, that is, to the Campanularians. This group Professor Agassiz proposes to divide into no less than three distinct families,—*Oceanidæ*, *Eucopidæ*, and *Laodiceidæ*. As in the case of the *Corynidæ*, a number of Naked-eyed Medusæ, whose structure is akin to that of the medusoids known to originate from the several Hydroids described, are placed with them in the same families and genera.

The first family contains those creeping Campanularians, referred by Johnston to the genus *Campanularia* proper. *Clytia poterium* is referred to a new genus, *Orthopyxis; C. bicophora* and *C. intermedia* to *Trochopyxis*, or *Clytia* proper; and *C. cylindrica* to *Platypyxis*, the medusoids of which are free. These, like others of the same family, have "free eyes between their tentacles," and closely resemble the young of *Tiaropsis diademata*, one of the Acalephs described with so much detail in the author's former essay on the Naked-eyed Medusæ of Massachusetts. Some additional observations on the marginal bodies and immature condition of this species are here inserted in a special section.

The three Campanularians which follow are members of the family *Eucopidæ*, the eye-specks of their medusoids being "attached to the base of the tentacles." The medusoids of *Laomedea amphora* never emerge from the reproductive calicle ('gonotheca,' or 'gonangium' of Allman) within which they are developed. Both *Obelia* and *Eucope*, however, possess free medusoids, the names of these genera having been originally given to what were looked upon as independent forms of *Discophora*. The free zoöids of *Eucope* are very nearly related to most of the Naked-eyed Medusæ usually referred to *Thaumantias*. So close is this resemblance, that the adult medusoid of *E. diaphana* was formerly described as a *Thaumantias* by Professor Agassiz himself, in the memoir mentioned above.

Of the third family of Campanularians no species is here described. Its type is the *Campanularia dumosa* of Fleming. This species, "which belongs to the genus Lafœa of Lamouroux, produces Medusæ without eyes at all, one of which has been described as *Atractylis repens* by Mr. Wright." "My son (continues Professor Agassiz) has lately traced the development of a species of Hydroid from our coast, which I have identified with Lafœa cornuta, Lamrx., the type of the genus, originally found in Newfoundland. This establishes, beyond a doubt, the fact that there are several families among the Hydroids thus far referred to the genus Campanularia."

Dynamena [*Sertularia*] *pumila*, the last fixed Hydroid of which Professor Agassiz treats, is also remarkable as being the only one of whose specific identity with its European representative (living specimens of which were procured and carefully examined), he is now thoroughly assured. It is, morever, the most common American form of its genus, and the sole example of the second primary division of the *Sertularina*, including all those genera with sessile polypites, here described.

To the *Siphonophora* Professor Agassiz devotes but four pages, in which, after some general remarks on the sub-divisions of the group, a brief account is given of the North American *Physalia*, *P. Arethusa*. This species, when floating, always turns to the windward side that aspect of its body along which are arranged the largest tentacles; "and when the breeze is fresh, and the animal is driven before the wind, these tentacles are stretched to a most extraordinary length, varying, according to circumstances, from twenty to thirty, forty, and even fifty feet, and forming as many anchors upon which it rides, without being cast adrift." "I have observed them [he adds,] in stormy weather struggling in that way against the elements, in order to avoid being thrown ashore. It is curious to see how, under these circumstances, they change their position, by raising the pointed end of their air-bag, and throwing themselves suddenly upon the opposite side; but I have never seen them emptying their bag and sinking under the surface of the water." The general form of this *Physalia* is represented in a very beautiful plate. Few structural details are given.

Want of space at the end of the present volume forbids Professor Agassiz from enlarging further on the North American *Siphonophora*, which "for many years past," he has had "ample opportunities of investigating." We gladly, therefore, accept his promise to resume his "communications, upon this subject, on another occasion."

In the "Tabular View," with which Part IV. terminates, the genera, families and sub-orders of the *Hydroidæ* are thus given:—

Order **HYDROIDÆ.**

Sub-order I.—RUGOSÆ.*

Sub-order II.—TABULATÆ.*

Sub-order III.—TUBULARIÆ.

Family 1.—Clavidæ.

Clava, *Gmel.*
Syncoryna, *Ehr.*

Family 2.—Hydractinidæ.

Hydractinia, *Van Bened.*

Family 3.—Sarsiadæ.

Coryne, *Gärt.*
Syndictyon, *A. Ag.*
Corynitis, *McCr.*
Candelabrum, *De Bl.*
Dipurena, *McCr.*
Slabberia, *Forbes.*

Family 4.—Cytæidæ.

Cytæis, *Esch.* (not Sars).

Family 5.—Cladonemidæ.

Cladonema, *Duj.*
Eleutheria, *Quatr.*

Family 6.—Eudendroidæ.

Eudendrium, *Ehr.*

Family 7.—Tubularidæ.

Tubularia, *Linn.* (res).
Thamnocnidia, *Ag.*
Parypha, *Ag.*
Ectopleura, *Ag.*
Corymorpha, *Sars.*
Steenstrupia, *Forbes.*
Euphysa, *Forbes.*
Hybocodon, *Ag.*

Family 8.—Pennaridæ.

Pennaria, *Goldf.*
Globiceps, *Ayres.*
Zanclea, *Gegenb.*

Family 9.—Bougainvillidæ.

Bougainvillia, *Less.*
Margelis, *Steenst.*
Lizzia, *Forbes.*
Rathkia, *Br.*
Köllikeria, *Ag.*

Family 10.—Nemopsidæ.

Nemopsis, *Ag.*
Acaulis, *Stimp.*

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* For the families and genera of these groups reference is made to the works of Milne-Edwards and Haime. The *Tubulosa* Professor Agassiz regards as low forms of *Tabulata.*

Family 11.—Berenicidæ.

Berenix, *Pér. & LeS.*
Cuvieria, *Pér. & LeS.*
Eudora, *Per. & LeS.*
Proboscidactyla, *Br.*
Willia, *Forbes.*

Family 12.—Nucleiferæ.

Conis, *Br.*
Turris, *Less.*
Tiara, *Less.*
Pandea, *Less.*
Turritopsis, *McCr.*
Modeeria, *Forbes.*
Stomotoca, *Ag.*
Rhizogeton, *Ag.*

Sub-order IV.—SERTULARIÆ.

Family 1.—Aglauridæ.

Aglaura, *Pér. & LeS.*
Lessonia, *Eyd. & Soul.*

Family 2.—Circeidæ.

Circe, *Mert.*
Persa, *McCr.*
Mitra, *Less.*

Family 3.—Polyorchidæ.

Polyorchis, *A. Ag.*

Family 4.—Melicertidæ.

Melicertum, *Oken.*
Gonionemus, *A. Ag.*

Family 5.—Laodiceidæ.

Laodicea, *Less.*
Staurophora, *Br.*
Laphæa, *Lamx.*
Trichydra, *Wright.*

Family 6.—Eucopidæ.

Obelia, *Pér. & LeS.*
Eucope, *Gegenb.*
Laomedea, *Lamx.*

Family 7.—Oceanidæ.

Oceania, *Pér & LeS.*
Eucheilota, *McCr.*
Clytia, *Lamx.*
Platypyxis, *Ag.*
Wrightia, *Ag.*
Tiaropsis, *Ag.*
Orthopyxis, *Ag.*
Hincksia, *Ag.*

Family 8.—Sertularidæ.

Dynamena, *Lamx.*
Diphasia, *Ag.*
Amphisbetia, *Ag.*
Sertularia, *Linn.*
Amphitrocha, *Ag.*
Cotulina, *Ag.*
Lineolaria, *Hincks.*
Thuiaria, *Flem.*
Halecium, *Oken.*

Family 9.—Plumularidæ.

Aglaophenia, *Lamx.*
Plumularia, *Lmk.*
Nemertesia, *Lamx.*

Family 10.—Æquoridæ.

Æquorea, *Pér. & LeS.*
Crematostoma, *A. Ag.*
Melicerta, *Less.*
Mesonema, *Esch.*
Zygodactyla, *Br.*
Rhegmatodes, *A. Ag.*
Stomobrachium, *Br.*

Family 11.—Geryonopsidæ.

Eirene, *Esch.*
Tima, *Esch.*
Eutima, *McCr.*
Orythia, *Pér. & LeS.*
Saphenia, *Esch.*

Family 12.—Geryonidæ.

Geryonia, *Pér. & LeS.*

Family 13.—Leuckartidæ.

Leuckartia, *Ag.*
Liriope, *Gegenb.*
Xanthea, *Less.*

Family 14.—Trachynemidæ.

Trachynema, *Gegenb.*
Tholus, *Less.*
Sminthea, *Gegenb.*
Rhopalonema, *Gegenb.*
Hypsonema, *Ag.*
Gossea, *Ag.*

Sub-order V.—PORPITÆ.

Family 1.—Velellidæ.

Velella, *Lmk.*

Family 2.—Porpitidæ.

Porpita, *Lmk.*

Sub-order VI.—PHYSALIÆ.

Family 1.—Physalidæ.

Physalia, *Lmk.*

Sub-order VII.—PHYSOPHORÆ.

Family 1.—Pethosomeæ.

Gleba, *Forsk.*
Vogtia, *Köll.*

Family 2.—Physophoridæ.

Physophora, *Forsk.*
Haplorhiza, *Ag.*
Discolabe, *Esch.*
Angela, *Less.*

Family 3.—Agalmidæ.

Agalma, *Esch.*
Crystallomia, *Dana.*
Temnophysa, *Ag.*
Sphyrophysa, *Ag.*
Stephanomia, *Pér. & LeS.*
Forskalia. *Köll.*
Agalmopsis, *Sars.*
Halistemma, *Huxl.*
Phyllophysa, *Ag.*
Cuneolaria, *Eysenh.*

Family 4. Apolemiæ.

Apolemia, *Esch.*

Family 5.—Anthophysidæ.

Athorybia, *Esch.*

Family 6.—Rhizophysidæ.

Rhizophysa, *Pér & LeS.*

Sub-order VIII.—DIPHYÆ.

Family 1.—Prayidæ.

Praia, *Q. & G.*
Sphæronectes, *Huxl.*

Family 2.—Diphyidæ.

Diphyes, *Cuv.*
Muggiæa, *Busch.*
Huxleyia, *Ag.*
Galeolaria, *DeBl.*

Family 3.—Abylidæ.

Abyla, *Q. & G.*
Calpe, *Q. & G.*
Bassia, *Q. & G.*

Throughout the whole of this Tabular View, Professor Agassiz deals very freely with the groups of his predecessors, sub-dividing, suppressing and redistributing them, at the same time establishing several of his own, and, in consequence, laying himself open to much criticism. Thus the placing of *Eudendrium* in a family by itself, apart from the *Bougainvillidæ*, with the curt definition of "No free Medusæ," is surely not justifiable. Nor can we, in fairness, sanction the adoption of a number of other and more important changes, in favour of which no reasons whatever are given; such, for example, as his re-construction of the genus *Diphyes*, and the admission of many of the obscure species and genera founded by the French navigators. Our author, in fact, seems to struggle with difficulty under the vast mass of materials which his industry has collected, and, if internal evidence may be trusted, is far from being familiar with the contents of many of the memoirs which he cites. Like the magician of old, perplexed with the crowd of phantoms which his wand had summoned but was not able to disperse, so do we find him often encumbered with the ghosts of the bad species established by Lesson, Péron and LeSeueur, and others. The valuable researches of Allman on the reproduction of the fixed Hydroids, which anticipate so much of what Professor Agassiz has himself achieved in the same field, are passed by with little notice. Yet if in some instances he is thus neglectful, he has also thrown a great deal of light on the embarrassed synonomy of the extensive hydroid group, and has tended not a little to further the advance of those who choose to follow in the same path of inquiry.

In the notes to the same Tabular View the following new forms of Naked-eyed Medusæ are described by the author and his son, Alexander Agassiz.

Coryne Rosaria, *A. Ag.*
Syndictyon reticulatum, *A. Ag.*
Dipurena conica, *A. Ag.*
Ectopleura ochracea, *A. Ag.*
Stomotoca atra, *A. Ag.*
Polyorchis penicillata, *A. Ag.*
Melicertum georgicum, *A. Ag.*
Gonionemus vertens, *A. Ag.*
Laodicea cellularia, *A. Ag.*
Laodicea calcarata, *A. Ag.*
Oceania languida. *A. Ag.*
Oceania gregaria, *A. Ag.*
Eucheilota duodecimalis, *A. Ag.*
Æquorea albida, *A. Ag.*
Crematostoma flava, *A. Ag.*
Zygodactyla cyanea, *Ag.*
Rhegmatodes tenuis, *A. Ag.*
Rhegmatodes floridanus, *Ag.*
Stomobrachium tentaculatum, *Ag.*
Eirene cœrulea, *Ag.*
Tima formosa, *Ag.*
Eutima limpida, *A. Ag.*
Eutima pyramidalis, *Ag.*

For the convenience of some of our readers we have drawn up the following table, in which Professor Agassiz' names for the species described in Forbes' Monograph of the British Naked-eyed Medusæ are given.

BRITISH NAKED-EYED MEDUSÆ.

Names of Forbes.		*Names of Agassiz.*
Willsia Stellata		Willia stellata
Turris digitalis		Turris digitalis
„ neglecta		„ neglecta.
Saphenia dinema		Stomotoca dinema.*
Oceania octona „ episcopalis „ turrita	†	Tiara octona.
„ globulosa		Pandea globulosa.
Stomobrachium octocostatum		Melicertum pusilla.
Circe rosea		Circe rosea.
Geryonia appendiculata		Liriope appendiculata.
Tima Bairdii		Tima Bairdii.
Geryonopsis delicatula		Eirene viridula.
Thaumantias pilosella		Laodicea stauroglypha.
„ quadrata „ æronautica „ octona „ maculata „ melanops „ globosa	‡	Platypyxis octona.

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* "The genus Saphenia *Esch.* is well founded, but embraces entirely different species from those referred to it by Forbes, and belonging to a different family, the Geryonopsidæ."

† These, with the *Oceania saltatoria* of Sars, "are probably different stages of growth of the same species."

‡ These, which appear to be "the same species," belong either to *Platypyxis* or to some other genus of the same family.

Thaumantias convexa	Oceania convexa.
„ gibbosa	Oceania gibbosa.[*]
„ lineata	Oceania phosphorica.
„ pileata	
„ sarnica	
„ hemisphærica	
„ inconspicua	
„ punctata	
„ Thompsoni	Obelia sphærulina.
„ lucifera	Eucope lucifera.
Slabberia halterata	Slabberia halterata.
Sarsia tubulosa[†]	Coryne pusilla.
„ pulchella	Ectopleura pulchella.
„ gemmifera	? Hybocodon gemmifera.
„ prolifera	? „ prolifera.
Bougainvillea britannica	Margelis ramosa.
„ nigritella	„ nigritella.
Lizzia octopunctata	Lizzia octopunctata.
„ blondina	„ blondina.
Modeeria formosa	Modeeria formosa.
Euphysa aurata	Euphysa aurata.
Steenstrupia rubra	Steenstrupia rubra.
„ flava	„ flava.[§]

The *Polyxenia* (*Pegasia*) *Alderi* of Forbes, has been excluded from the above table, since it appears to belong to the *Æginidæ* and, consequently, to the true *Discophora*.

The law of priority is pushed to its extreme limits by Professor Agassiz. When the same genus includes well-marked hydroid and free medusoid forms, he does not hesitate to adopt for both, collectively, the name first given to either. Thus *Stauridia* (Wright), becomes a synonym of *Cladonema* (Dujardin), and the *Eleutheria* of De Quatrefages is made to embrace the recently established *Clavatella* of Hincks. There is much to be said in favour of this mode of procedure. Why, indeed, it should so often have been disregarded in those cases where the medusoid happened to have been the first discovered form,—we can only ascribe to the mischievous influence which theories exert on the minds of naturalists unable to realize them.

The genus *Hydra* does not occur in Professor Agassiz' list; its omission being, most probably, unintentional. His *Syncoryna* (of Ehrenberg, restricted), includes the *Sertularia parasitica* of Cavolini, and the *Cordylophora*[||] of Allman. The new genus *Syndictyon* is said to resemble *Coryne*, but its hydroid is not described. *Candelabrum* is equivalent to *Myriothela*, Sars, Mr. Stimpson having shown that the *C. phrygium* of De Blainville (*Lucernaria phrygia*, Fabricius) is an older discovered form of the same genus. *Ectopleura*, besides the *Tubularia Dumortieri* of Van Beneden, is made to include four species of *Sarsia*, among them the *S. pulchella* of Forbes. In the table of contents it is stated "that Euphysa belongs to the cycle of Hybocodon; but it remains to be seen whether the Medusa, here described as Hybocodon, is transformed into a genuine Euphysa, or the Euphysa produced from the tentacular buds of an Hybocodon." As already hinted, *Bougainvillea* and *Margelis* appear to be synonymous with the *Perigonymus* of Sars. Of the other new genera, *Kölllikeria* includes some Medusæ allied to *Lizzia*, but having eight bunches of tentacles; *Nemopsis* is remarkable as affording the only known example of a free Hydroid; *Stomotoca* is equivalent to *Saphenia*, Forbes. *Trichydra*, Wright, is transferred to the *Sertulariæ*, together with the *Atractylis repens* of the same observer. The medusoid of *Trichydra* is still unknown.

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[*] This "constitutes, probably, a distinct genus."

[†] This and the remaining species, except *Modeeria formosa*, would seem to be undoubted medusoids.

[§] Is, "perhaps, only another state of *S. rubra*."

[||] Misspelt *Cordylomorpha*.

The *Sertulariæ* with fixed reproductive zoöids correspond to the eight and ninth families in the above list, and the Campanularians, with their associated medusoids, to the three families immediately preceding them. The remaining families chiefly include Medusæ; little, if anything, being accurately known of the Hydroids from which some, at least, of them originate. *Sertularia*, as restricted by Johnston, is here divided into no less than six genera; *S. pumila* being referred to *Dynamena*, *S. operculata* to *Amphisbetia*, *S. polyzonias* to *Cotulina*, *S. rugosa* and *S. picta* to *Amphitrocha;* while *Sertularia* itself contains only the excurrent form *S. cupressina*, with its near allies, and perhaps also *Plumularia falcata*, the remaining species being placed in *Diphasia*. The older name *Nemertesia* is rightly substituted for the *Antennularia* of Lamarck, and *Campanularia tincta* is elevated to the rank of a distinct genus, *Hinksia*, so named in honour of its discoverer. In like manner, *Campanularia syringa* and its allies, (among which, however, we cannot follow our author in bringing the *Laomedea acuminata* of Alder), form the new genus *Wrightia*. *Polyorchis*, *Gonionemus* and *Rhegmatodes* are genera of Naked-eyed Medusæ established by Alexander Agassiz for newly-discovered forms. So is, likewise, his *Crematostoma*, which includes, also the *Mesonema pilens* of Lesson. *Leuckartia* has been established for *Geryonia probosidalis*, Leuck.; *Hypsonema*, for *Cytæis polystyla*, Will.; and *Gossea* for *Thaumantias corynetes* of Gosse.

Turning now to the *Siphonophora*, we are sorry to find that Professor Agassiz rejects the very natural group *Calycophoridæ* of Leuckart, and refuses to admit the unity of organisation which prevails among the float-bearing Hydrostatic Acalephs. The division of these last into three sub-orders must be looked upon as a retrograde step. To the sub-order *Physophoræ* the *Hippopodidæ*, which bear no float, are referred; the only reason given for separating this family from its natural allies being that, "the communities of the Hippopodidæ have not the same organic complication as the Diphyidæ, while the Prayidæ have." With regard to the doubtful species of Siphonophora, "described by Quoy and Gaimard in the Zoölogy of the Astrolabe, most of which are figured from imperfect specimens," Professor Agassiz has here "attempted to classify them, according to the method so successfully applied in the study of fossil remains, comparing the parts preserved and illustrated by the French zoölogists, with corresponding parts of the European species, now fully known by the extensive researches of Milne-Edwards, Kölliker, Leuckart, Vogt, Gegenbaur, and Huxley." Such a method of treatment has, at least, the merit of ingenuity, and cannot fail to be followed in practice by those who have leisure and inclination for so doing. But the conjectural results thus obtained, however desirable it may be to embody them in supplemental lists, ought by no means to find a place in the more permanent nomenclature of scientific zoölogy. There is, also, a distinction between the study of figures and of objects themselves. The imperfect knowledge which must content us in the case of fossil remains, seems scarcely worth striving for, when we pass to existing organisms of which uninjured specimens will, doubtless, in due course, be met with, and examined with every aid to complete investigation.

We have read with some surprise the statement of Professor Agassiz that, in characterising the *Siphonophora* he has "purposely avoided the special nomenclature devised by the German naturalists to describe the Siphonophoræ, and reproduced in an Hellenic garb by Huxley, in order the more directly to show the close affinity of these animals with the Hydroids. It is a fact constantly recurring in our science, that special names are required to designate the parts of animals, the homologies of which are not fully ascertained; but as soon as their structural identity ceases to be doubtful, it seems to me best to discard such technicalities, and I believe the time has come when the Siphonophoræ may be described in the same words as other Acalephs." In reply to this we feel ourselves compelled to say a few words. The writers to which Professor Agassiz here refers, particularly our English colleague, do in fact describe the *Siphonophora* in the very same words as other animals belonging to the same class, and insist strongly on the homologies existing between them. The "General Introduction" prefixed to the Ray Society's Monograph of the Oceanic Hydrozoa has always appeared to us written with a view to establish and demonstrate the very position which Professor Agassiz would now claim for himself. As to the technicality of the nomenclature (or, more correctly, the terminology) which he condemns, we do not see in what respect such words as 'polypite' 'cœnosarc' and 'gonophore' are a whit more abstruse or deterrent than some of his own terms, for example,—'spherosome,' 'abactinal' and 'hydromedusarium!'

Part IV. concludes with a few lines on the Geographical Distribution of the *Hydroidæ*, in which the Author expresses his opinion that the "Hydroids, are localized within narrow boundaries, with as much precision as the higher orders of the class." The *Diphyidæ*, he thinks, furnish only apparent exceptions to this rule. But for the present he considers it premature to generalise on the subject.

Part V., on the HOMOLOGIES OF THE RADIATA, ends at once the volume and the Monograph. It includes only six pages, and is divided into two short sections, of which the first discusses general homologies, while the second enters on the special homologies of the classes.

In the first section, after some cautions, as to the position in which, when studying their homologies, these animals should be placed, Professor Agassiz re-asserts his former conclusion that the body of every Radiate is essentially a sphere, "loaded in every direction with those structural differentiations which determine the peculiarities of organic structures." This sphere resolves itself into a number of wedges, or 'spheromeres,' "arranged symmetrically around a vertical axis." These wedges form, superficially, a number of alternate zones, reaching from pole to pole. "The so-called mouth is always placed at one of these poles, and from it radiate the most prominent organs, in consequence of which I have called this side of the body the oral, or *actinal* area, and the opposite side the aboral, or *abactinal* area;" while the zones, ambulacral and interambulacral, "differ chiefly in the differentiation of the substance, and the position of different systems of organs alternating with one another at the periphery of the body."

In the second section the author endeavours to show that a radiate arrangement of the parts, such as that just described, may be traced in the classes of Acalephs, Polyps, and Echinoderms, respectively. The longitudinal ambulacral tubes of the last-mentioned class, the body-chambers of the Polypes, and the radiating canals of the Medusæ, (or, at least, some of them), are here stated to be strictly homologous with one another. The holes by which the chambers of the Polypes communicate, not far below the oral disk, are "homologous to the marginal circular tube of the Acalephs, and are actually to be considered as short tubes through narrow walls, leading into wide radiating chambers." Lastly, the gastric sac of the true Polypes is homologous to the oral apparatus of the Jelly-fishes, and is compared to the "neck of a bottle, which in Polyps would be turned inside, while in Acalephs it is turned out and divided into a number of distinct lobes."

Intimately connected with the subject-matter of this portion of the work is the more detailed survey taken in Part III. of the "Homological Relations of Aurelia and Echinoderms." Our readers are already aware how Professor Agassiz resolves the radiating canals of *Aurelia* into two systems, one 'ambulacral' and one 'interambulacral,' the latter being in direct connection with the genital pouches. The elements of these two systems alternate with one another, respectively. So, also, is it among the Echinoderms where, besides, the proper ambulacral apparatus so long known, there exists, according to our author, a quite distinct series of interambulacral vessels. In his next monograph, on the North American Echinoderms, Professor Agassiz promises to "give a full account of the structure and connections of this complicated system." So long, however, as homology means similarity in relative position of parts, we must continue to deny the existence of any true homological correspondence between the canal-systems of the Acalephs and Echinoderms, for while those of the former freely communicate with, and indeed form portion of, the general body cavity, those of the latter are quite distinct from it. Yet on the presumed existence of such an homology, Professor Agassiz rests his chief argument for abolishing the subkingdom *Cœlenterata.*

XLIX.—FLORA AUSTRALIENSIS; A DESCRIPTION OF THE PLANTS OF THE AUSTRALIAN TERRITORY. By G. Bentham, F.R.S., F.L.S., assisted by Ferd. Müller, M.D., F.R.S. and L.S. Government Botanist, Melbourne, Victoria. Vol. 1. Ranunculaceæ to Anacardiaceæ. London: Lovell Reeve and Co.

FLORA CAPENSIS: BEING A SYSTEMATIC DESCRIPTION OF THE PLANTS OF THE CAPE COLONY, CAFFRARIA AND PORT NATAL. By W. H. Harvey, M.D., F.R.S., Prof. of Botany in the University of Dublin, and O. W. Sonder, Ph. D. of Hamburgh. Vol. 1. Ranunculaceæ to Connaraceæ. Dublin: Hodges, Smith and Co.

IN the volume of this Review for 1861, (p. 255,) there appeared a brief account of the measures adopted by the Director of the Royal Gardens, Kew, to induce the Home and Colonial Governments to encourage the publication of inexpensive Floras of the British Colonies. It is the object of the present article to inform our readers of the measure of success which has attended these efforts, of the prospects, such as they are, of so useful a project being fully carried out, and to review two of the most important volumes of the series which have hitherto appeared.

West Indies.—The Flora first begun, was that of the British West Indian Islands, for the authorship of which H. M. Secretary of State for the Colonies granted a sum of £300, and which was undertaken by one of the most accomplished Continental Botanists, Dr. Grisebach, Professor of Botany at Göttingen. Of this work five parts have appeared, and are offered for sale by Messrs. Reeve for 5*s* each; another part, now in the press, will, we understand, complete the work, which will then contain descriptions of no less than 3000 tropical plants, at the cost of 30*s*. This is undoubtedly by far the most inexpensive systematic botanical work ever published, and is a remarkable instance of condensation in regard to matter and type. When concluded, which will be in the course of a very few weeks, we shall take an early opportunity of presenting an analysis of its contents to our readers.

Hong Kong.—Next appeared the Hong Kong Flora, which was completed in one volume, by Mr. G. Bentham, F.R.S., previous to the appearance of the article on Colonial Floras above alluded to.

British N. America.—With regard to the British North American Colonies, much correspondence has taken place between Sir W. Hooker, and the Colonial Office, the Governor General and Governors of the Colonies themselves, various scientific and otherwise influential gentlemen in Toronto, Montreal, and elsewhere, and, finally, several of the Commissioners for those Colonies who were present at the International Exhibition of 1862. At present all that can be reported is, that the feeling in favour of the undertaking is unanimous, that the required grant is considered so small as to be no obstacle whatever, and that no objection of any kind has been raised. For want, however, of some influential person at head-quarters, or from some other cause, no action has as yet been taken by the Governments before whom the proposal lies. The projected Flora would include all the British N. American Colonies in one work of two or three volumes, requiring a grant of £150. per volume as remuneration for the Author, and the purchase on the part of the Colonial Governments of 100 copies of each volume, (at a price not exceeding £1. per copy,) as encouragement to the publisher. The total expense to each colony would not thus amount to more than £100, if each contributed an equal quota, and it were spread over some two or three years. An annual grant of £40. a piece would cover the whole!

New Zealand.—The Colonial Government of New Zealand have promptly responded to the proposal, and commissioned Dr. Hooker to prepare a Manual of the Flora of its territories upon the same plan, form, and size, &c., as the Hong Kong Flora, but to include the Cryptogamic as well as Flowering plants. This is the more liberal on the part of this energetic Colony, as it had on the completion of the volumes of the Botany of the Antarctic Expedition, which described all the New Zealand plants then known, spontaneously proposed a grant of £350. to its author, in recognition of the scientific service he had thereby rendered to the Colony. The Manual of the New Zealand Flora is now in progress, and it is hoped that a volume will appear in the present year.

Ceylon.—The Government of this prosperous Colony is, we are given to understand, prepared to make the necessary grant for the publication of its Flora, whenever the present accomplished Director of the Gardens, G. H. K. Thwaites, Esq. is ready to undertake it. In the meantime that author's preliminary work, "Enumeratio Plantarum Zeylaniæ," is rapidly approaching completion; the Filices being now in the press.

West African Colonies.—No decided steps have hitherto been taken with regard to the West African Colonies, but it is most earnestly to be desired, that measures should be adopted speedily for publishing the magnificent collections of tropical African plants, Colonial and other, that have been accumulating during the last twenty years, from the combined exertions of many most distinguished voyagers and travellers. These abound in interest and novelty, and are amply sufficient to afford an excellent general knowledge of the vegetation of Tropical Africa, in all its aspects. They consist in the main;—of Niger-valley plants collected partly by Dr. Baikie, the intrepid and energetic commander of the Niger expedition, who has spent no less than ten years on the river and its tributaries, but mainly by Mr. Barter, who was for five years the active and indefatigable Botanist to this expedition, and fell a victim to the climate; —of the large collections made by Dr. Kirk, and latterly by Dr. Meller, during Livingstone's Zambesi, Shire, and Makololo country expeditions, and which contain a large and valuable series of notes and analyses made by the first-named accomplished naturalist;—of the magnificent collection made by Gustav Mann, the successor to Barter, but who never having found the means of joining the Niger expedition, was employed by the Admiralty in collecting upon the coast, islands, and mountains of the Gulf of Guinea, and who has successfully explored the Cameroon Mountains, the peaks of Fernando Po, St. Thomas, and Princes Island, the Gaboon river, Sierra del Crystal, and various places on the coast of Tropical Africa, between Sierra Leone and the Gaboon;—the excellent collection made chiefly by Capt. Grant during Speke's explorations of Central Africa, and the upper part of the Nile;—and lastly, of miscellaneous collections often of great extent and value, made by Petherick, Mansfield Parkyns, Vogel, Roth, &c. in Abyssinia, Nubia, Kordofan, and Upper Egypt.

The expeditions through which these collections have been obtained at so great a sacrifice of life, and at so great peril to the survivors, have been all equipped either by or under the immediate superintendence of the Foreign Office and Colonial Office; and it is to be hoped, that the small grant required for their publication, (amounting in all to only £1200. for authors' remuneration and purchase of copies,) will be obtained from the Treasury very shortly, and the work speedily commenced.

Mauritius and Seychelles, &c.—With regard to the Flora of the Mauritius and Seychelles, of Honduras, and of British Guiana, as yet, nothing has been done, nor are our collections from these countries sufficiently complete to found full Floras upon.

Australian Colonies.—In the above quoted article it was stated, that the Lords of the Treasury had refused to sanction the application on the part of the Secretary of State for the Colonies, for a small sum to defray the expenses of a Flora of the Australian Colonies. Foiled in this quarter, Sir W. Hooker immediately interested himself with the

Colonies themselves, and transmitted to them from Mr. Bentham, a specific offer on that Botanist's part, to describe all the plants of their continent in the same form and style as the Flora of Hong Kong, and at the same rate of remuneration. This application was instantly responded to by Sir John Young, Governor-in-chief of the Australian Colonies; Sir H. Barkly, Governor of Victoria; Sir G. Bowen, Governor of Queensland; and Sir D. Daly, Governor of South Australia, by their laying the proposal before their respective Parliaments, who accepted each a share of the expense, and conjointly commissioned Mr. Bentham to proceed with the work. Western Australia alone pleaded inability on pecuniary grounds. The colony of Victoria, justly proud of her eminent colonial explorer and botanist, Dr. Mueller, would gladly have seen the work entrusted to that indefatigable author, than whom no one was better qualified for the undertaking, whether by special study or by personal experience of Australian plants, throughout a great part of that vast continent. But many circumstances rendered it impossible that Dr. Mueller should carry out such a work; amongst others one was insuperable: viz. that almost all the early Australian Herbaria were in London, and must be studied and quoted; including Banks and Solander's made during Cook's first voyage, Brown's made during Flinders' expedition, Allan Cunningham's made during King's voyage and his subsequent expeditions, which together extended over twenty years continuously employed in travelling and collecting; all the Tasmanian plants of Gunn, and others; S.W. Australian of Drummond; of Baxter from King George's Sound, and the Herbaria made during the coast voyages of the "Herald," "Rattlesnake," "Beagle," and other Government surveys; besides a host of minor collections formed by Mitchell, Sturt, Grey, Bidwell, Hill, Caley, Sieber, Moore, Macarthur, &c., in many parts of the coast and interior. Then, too, there was the necessity of studying the materials contained in the Paris and Vienna Herbaria, and comparing the important type specimens of Preiss, belonging to Dr. Sonder of Hamburgh, which form the basis of two volumes on the plants of S.W. Australia, containing descriptions of two thousand species, many of them bad, and more imperfectly described. Of these and other drawbacks, Dr. Mueller was fully sensible, and acting up to his convictions, he unhesitatingly withdrew all his claims to the authorship of a work, for which he had made extensive preparations, and to the publication of which he had long looked forward as the height of his ambition; and preferring Mr. Bentham's claims on these and other grounds of a scientific nature, to his own, he earnestly recommended the acceptance of his offer on the part of the Victorian Government. Nor did Dr. Mueller's disinterestedness cease here, for he further proposed that £100. of the Colonial grant annually made to him for his own publications, in connection with the Victorian Flora, should be transferred to that of Mr. Bentham's Australian Flora; and made arrangements to transmit the whole of his magnificent Herbarium by instalments to Kew, to aid in the preparation of the work, for which he has since uninterruptedly continued to labour with as much zeal as if it were his own.

Such instances of scientific self-sacrifice are indeed rare; not, we believe, because the feelings that have dictated this one act are unusual or feeble amongst naturalists; but because the circumstances are entirely exceptional. On the one hand, we have Dr. Mueller's immense ardour, his practical knowledge of Australian Botany, and his almost unparalleled powers of work, allurging him to an undertaking of which any Botanist would desire to be called the author, and in the prosecution of which he could count on the most liberal support of a wealthy Government justly proud of their servant, and eager to connect its name with that of a national work, which would give it a scientific renown above that of its sister colonies; on the other, the offer of a private gentleman, in no way connected with the colony, personally unknown to every member of it, but confessedly the first Systematic Botanist of his age.

Under these auspices the "Flora Australiensis" has been begun, and within little more than a year after its being determined on, we have the first volume published by Lovell Reeve and Co., who have undertaken the whole series of Colonial Floras. The volume is of the same form, type and arrangements as the Hong Kong Flora, is preceded by a brief introduction to Botany, and is, in short, conducted in conformity with the plan projected by Sir W. Hooker, for the whole series of Colonial Floras, and given at p. 264 of the volume of this Review for 1861. This first volume contains the orders from Ranunculaceæ to Anacardiaceæ inclusive, and describes about 1072 species, included in 253 genera and 39 natural orders. In the ordinal and generic characters there is little to observe, these being necessarily almost the same with the author's "Genera Plantarum" which indeed appeared during the elaboration of this volume, and for the new views embodied in which we may therefore refer to the Review of that work, N. H. R., Vol. III., p. 31. The specific characters are excellent, and the diagnoses preceding them very clear and good; in these qualities we perceive no falling off of the author's well known and remarkable powers, but the contrary. This is no doubt due to his having to deal with many very large genera abounding either in nearly allied species, or species which can only be discriminated by minute characters, or such as are not easily defined by words; and to the necessity of bearing constantly in mind, that his descriptions, which are drawn from dead materials, must nevertheless, prove useful both to beginners, and to proficients who have fresh specimens to work upon; and hence the necessity of selecting characters that are both constant and discernible, in organs that are sure to be found in the living plant, however difficult of detection they may be in the dry state.

Of the well known features of the Australian Flora, some come out prominently in this volume, because the Thalamifloræ are fairly represented by numerous Endemic genera and species, though whether so much so as the Calycifloræ, Corollifloræ, Monochlamydeæ, or Monocotyledons, we are not prepared to say. Some of the less understood, but equally important peculiarities of the Flora are here for the first time most instructively shown; such as the prevalence of certain Indian genera and species, especially in the N.W. and N.E. coasts, and the absence of others (as Dipterocarpeæ), which abound on some of the neighbouring Malayan Islands.

Of the Orders, all but two (Tremandreæ and Stackhousiæ) are Indian, and indeed one species of the latter is found in the Philippine Islands; and but one Order (Tremandreæ) is wholly endemic. No less than 15 of the 39 Orders are British, and 25 are European; whilst of the genera upwards of 140 are Indian, and include no less than 120 Indian species. Of the genera 50 are European with about 20 species, of which many are Northern types and some of these confined in the Australian Continent to the Australian and Tasmanian Alps. These interesting wanderers are:

Ranunculus aquatilis, and *R. parviflorus.*
Myosurus minimus.
Nasturtium palustre.
Barbarea vulgaris.
Arabis glabra.
Cardamine hirsuta.
Draba muralis.
Capsella procumbens.
Senebiera didyma.
Lepidum ruderale.
Stellaria glauca.
Sagina procumbens.
Spergularia rubra.
Montia fontana.
Geranium dissectum.

The other boreal genera are *Anemone, Caltha, Papaver, Thlaspi, Gypsophila, Viola, Polygala, Frankenia, Elatine, Hypericum, Erodium, Oxalis;* besides a few others which, like *Tribulus* and *Zygophyllum,* extend into southern Europe, but are tropical rather than temperate forms.

The above list suggests many reflections, of which the most attractive no doubt is that relating to the common origin, subsequent dispersion, and final segregation in the temperate regions of the Northern and Southern hemispheres of the plants enumerated. Of their birth-place as species nothing is yet known, whilst to account for their dispersion and segregation, only one theory has been advanced that is at the same time tenable and probable; we allude to Mr. Darwin's, which assumes that these and other boreal forms were driven from our temperate zone into the tropical during the cold of the glacial epoch, and, on the return of warmth, migrated in opposite directions back towards the Poles, ascending the mountains that crossed their line of march. This is not the place wherein to discuss this plausible hypothesis, though it may be remarked here that it demands a persistence of specific type through enormous periods, and over enormous areas, and under incalculable changes of conditions, that at first sight tells against Darwin's own theory of the origin of species by natural selection. His ready answer would be, that though these species have not changed, others have; and, carrying the war into the enemy's camp, he might thus quote the 'Flora Australiensis' in his support:—

1. He finds from it that some of the species, as *Geranium dissectum*, are described as appearing under a totally different form in the Southern from what they do in the Northern hemisphere, and that these forms would not have been considered conspecific but for the fact of intermediate states being preserved in intermediate localities.

2. That other Southern species approach so nearly to boreal ones, that some of them have been considered by previous observers to be identical with them, and are with difficulty separated by Bentham himself; as *Cardamine tenuifolia*, which closely resembles *C. pratensis*, and is only distinguished by a character which is valueless in the very next species (*C. hirsuta*); *Stellaria flaccida*, which in like manner (but on less good grounds), was regarded as a variety of *S. media*; *Ranunculus plebeius*, which is surely nothing but a southern form of *R. repens*; and *Papaver horridum*, which comes very close indeed to the European *P. dubium*.

3. That there are several genera so rare and obviously alien to the South that their presence there is in every way anomalous; as the genus *Anemone*, with but one species, which is confined to one small spot in Tasmania; and *Caltha*, which affects only the tops of the Tasmanian and Victorian Alps, and that these and others rather represent remnants of a different vegetation, than types created for special circumstances.

These certainly are strong points in favour of Mr. Darwin's hypothesis, in so far, that by them he would rivet each link in the chain of of his arguments with a bolt of undoubted strength and proved value, and we shall anxiously scan the future volumes of Mr. Bentham's work for further proof, or the contrary, of the general proposition his theory assumes.

The number of Indian species described for the first time in the 'Flora Australiensis' as Australian, together with the not inconsiderable reduction of small Australian genera to larger genera of wider distribution, relieve the Australian Flora, as represented in this volume, of much of the excessive peculiarity formerly attributed to it. Thus, out of the 243 genera, only about 80, or one-third, are exclusively Australian, or confined to Australia and New Zealand: but of these genera 28 include no less than 500 species, and amongst them are not only the largest genera in the Flora, but those which give most character to the vegetation. Such are—*Hibbertia* (67), *Candollea* (15), *Blennodia* (11), *Marianthus* (16), *Tetratheca* (18), *Comesperma* (21), *Rulingia* (13), *Thomasia* (25), *Lasiopetalum* (20). The six Rutaceous genera, *Zieria*, *Boronia*, *Eriostemon*, *Phebalium*, *Asterolasia* and *Correa* (together including 124 species), *Stackhousia* (10), the four Rhamneous genera, *Pomaderris*, *Trymalium*, *Spyridium* and *Cryptandra* (including together 69 species), and *Dodonæa*, with 38 peculiar species.

Altogether, about one-fourth of the species described in this volume were unknown to science previous to Dr. Mueller's and Mr. Bentham's investigations; most of the former author's new species had, however, been previously published in his 'Fragmenta Phytographiæ Australis,' or in other papers on the Australian Flora.

Amongst the Indian plants, those which attain the size of trees are especially worthy of notice, as indicating, perhaps, a closer previous insular or continental connection than shrubby or herbaceous plants do; such are *Cedrela Toona*, *Melia composita*, *Atalaya salicifolia*, *Berrya Ammonilla*, *Bombax Malabaricum*, *Brucea Sumatrana*, *Buchanania augustifolia*, *Calophyllum inophyllum*, *Erioglossum edule*, *Melhania incana*, *Micromelum pubescens*, *Pterosperma acerifolium*, *Semecarpus Anacardium*, *Schmidelia serrata*, *Sterculia fœtida*, *Ximenia Americana*, *Zizyphus jujuba*; besides, of littoral trees, *Carapa mol-luccensis*, *Colubrina Asiatica*, *Commersonia echinata*, *Dodonæa viscosa*, *Heritiera littoralis* and *Thespesia populnea*.

There is also a curious connection between the Australian and African and Madagascar Floras, which is quite independent of the Asiatic, and illustrated by such singular genera as *Keraudrenia*, of which the only extra-Australian species is a Madagascar plant, and some others, but this will be better brought out when more of the work appears.

With regard to the probable extent of the Australian Flora, a comparison of Bentham's critical study of the first 39 Orders, with the estimate of the same Orders made by Dr. J. Hooker for his 'Introductory Essay to the Flora of Tasmania,' shows a very close agreement—1072 species against 1040. If the future volumes show an equal approximation, the total number of flowering plants and ferns in Australia will approach 7000, and require six or seven volumes to include them all, in the present form.

Cape Flora.—Drs. Harvey and Sonders' Flora Capensis, alluded to in the original notice of Colonial Floras already referred to, has reached the second volume, which includes the orders Leguminosæ to Loranthaceæ; and the third, which will include the Compositæ by Dr. Harvey, is far advanced towards completion. It is with the first volume alone that we shall now concern ourselves, because of the many parallels it affords with the Australian volume just reviewed. Like it, the volume beginning with Ranunculaceæ ends just before Leguminosæ, and thus affords an accurate standard between two of the richest of the Floras of the Globe, both placed in the Southern Hemisphere—both terminating great continents—both eminently peculiar and abounding in Endemic forms, generic as well as specific, and both consisting for the most part of temperate plants.

In the comparisons of these Floras hitherto made, the palm for peculiarity has hitherto been awarded to Australia; how far this is a correct award cannot be known until a much greater advance is made in each of these two great descriptive works; as, however, the labour of comparing the two whole Floras when finished (probably containing an aggregate of upwards of 16,000 species) will be immense, we purpose to prepare the way for it by taking the volumes as they appear in couples.

In point of area the Australian Flora is much the largest, extending from Lat. S. 10° to 44° and Long. E. 113° to 153°: the Cape Flora embracing only from Lat. S. 23½° to 34½° and Long. E. from 15° to 35°. The Australian Flora includes a considerable tropical area, which the South African does not; but this is met in part by the facts that many more tropical African plants extend beyond the tropic of Capricorn in Africa than Asiatic plants do beyond the same tropic in Australia; and that the Australian tropical Flora is an extremely poor one. On the other hand a vast number of desert tropical forms extend in both the Australian and South African regions to very high South Latitudes, namely, to Adelaide in Lat. 35° and to Lat. 30° in South Africa.

Then with regard to the comparative temperatures of the Australian and South African areas under consideration, the isotherm of 60°, which passes through South-East and South-West Australia, also touches the Cape of Good Hope, near Cape Town; whilst the isotherm of 70° cuts the tropic of Capricorn obliquely in each continent. The average rain-fall is about the same in extra-tropical Southern Africa and Australia, and the equatorial limit of the fall of snow at the level of the sea passes through the Cape Colony and that of Victoria in Australia. Here then are certain very marked physical features common to Australia and South Africa; to which may be added, that the average amount of mountain area is not widely different in each, that in both the Alps reach about the same elevation, and in both areas there is a most striking difference between the vegetations of their Eastern and Western halves. This latter difference, though coincident with some climatic differences, is far greater than is found to obtain between Eastern and Western Europe, where much greater climatic differences prevail. The main difference between the two countries is however in area, that of the Cape Flora being less than one fourth of the Australian, and perhaps more exactly representing in extent and conditions the colonies of Queensland, New South Wales, and Victoria.

Proceeding now to compare the volumes, we have in Australia 39 Orders, from Ranunculaceæ to before Leguminosæ, and in the Cape 40;* the ordinal differences between the Floras being the presence

in Australia only of	in the Cape only of
Dilleniaceæ.	Resedaceæ.
Magnoliaceæ.	Tamariscineæ.
Tremandreæ.	Melianthеæ.
Guttiferæ.	Chailletiaceæ.
Simarubeæ.	Connaraceæ.
Stackhousieæ.	

Of genera there are in Australia 243, Cape 165.
Of species „ „ 1072, „ 1316.

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* A correction is here introduced for certain Orders in the Cape Flora ranked as sub-orders in the Australian; and for a few Orders being included as Thalamiflorae in the Cape Flora, but referred to other divisions in the Australian, or *vice versa*.

Thus the Cape Flora, so far as described, contains fewer genera and more species than the Australian, and is in short much less varied in character though more rich in specific forms. As in Australia there are here but two Orders that are altogether or almost endemic, Melianthеæ and Chailletiaceæ; the rest are widely diffused, being Asiatic, or European, or both.

Of the genera, not more than 40 are European, against 50 European in Australia, and of the species about 15 are European and Northern types against 20 in Australia. On the other hand about 65 genera out of 165 (or 1:2·5) are endemic or nearly so, whilst in Australia only 75 out of 243 (or 1:3·2) are so.

Then of the species, as near as can be estimated without entering into minutiæ, all but 100 or so of the 1316 are peculiar to Africa, which leaves a much larger proportion of endemic species in that Flora than occur in the Australian Flora.

The European plants of a more northern type contained in this volume of the Cape Flora are:—

Thalictrum minus.
*Ranunculus aquatilis.
*Nasturtium officinale.
Barbarea præcox.
?Arabis glabra.[*]
Alyssum maritimum.
Sisymbrium thalianum.
*Senebiera didyma.
„ Coronopus.
*Lepidum ruderale.
Frankenia lævis.
„ pulverulenta.
Hypericum humifusum.
Cerastium viscosum.
*Spergularia rubra.
Althæa Ludwigii.
Malva parviflora.

Those marked * are also Australian, whilst of other genera which are North European but not Australian, there are—*Corydalis*, *Matthiola*, *Brassica*, *Sinapis*, *Tamarix*, *Dianthus*, *Silene*, *Impatiens*, and *Erodium*.

The most remarkable ordinal and generic features common to the Australian and Cape Floras are the abundance of Rutaceæ proper (both endemic genera and species), in both, amounting to 15 genera and 145 species in Australia, and 10 genera and 178 species in the Cape; of Rhamneæ, wherein the peculiar genus *Phylica*, with 58 species, represents *Trymalium* and its allies with 69 species in Australia. Then Malvaceæ, Sterculiaceæ, Polygaleæ and Zygophylleæ are very prevalent in both Floras.

On the other hand, Cruciferæ (*Heliophila*), Geraniaceæ, Oxalideæ, and Celastrineæ are very abundant at the Cape, but comparatively rare in Australia, being, as it were, replaced in the latter by Dilleniaceæ, Pittosporeæ, and Sterculiaceæ. Except *Papaver horridum*, there is no species in the two volumes common to the Cape and Australia that is not also European or Asiatic, nor are there above

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[*] The *Turritis Dregeana*, Sond. does not differ, according to the description, from *Arabis* (*Turritis*) *glabra*.

20 species in all common to these two volumes, and no remarkable genera.

The Orders of any magnitude absent from both are Berberideæ, Cistineæ, Ternstrœmiaceæ, and Dipterocarpeæ.

The general result, then, of the above comparison is, that the Orders between Ranunculaceæ and Leguminosæ are all but the same in number in the Cape and Australia, and only differ in kind by about five Orders in each country; that the genera are much fewer in the Cape, but a larger proportion of these is endemic; whilst the species are not only more numerous at the Cape, but far more restricted to that area.

With regard to the representation of Northern forms in each Flora, Australia certainly is the richest, both as to the number of genera and species, and as to the character of them. With the exception of *Thalictrum minus*, there is no Cape plant of so boreal a character as *Stellaria glauca*, *Sagina procumbens*, *Montia fontana*, and several other plants found abundantly in the Australian and Tasmanian Alps, but absent in South Africa. This is a most suggestive fact, if considered in connection with that of there being an almost continuous continental extension between South Africa and Northern Europe, whilst Australia is an isolated continent.

The data supplied by these two volumes, however, justify nothing beyond a comparison of the prevalent conditions of those parts of the Floras which they respectively most fully and faithfully describe; and we shall wait their continuation with impatience, feeling sure that many more curious and instructive points will be brought out in them, and ample scope afforded for working the question of the origin of that host of endemic forms they each contain, by variation from a few pre-existing types, characteristic of countries from which their whole Floras may wholly or in part have been derived. So far as at present appears, the Australian Flora is the most complicated, though least rich of the two, consisting of Indian, European, and Antarctic types, vastly outnumbered by Australian endemic forms, that may or may not have arisen by variation and natural selection from the Indian and Antarctic. The Cape Flora consists of Indian types common to tropical Africa, and of a few European ones, both outnumbered by endemic Cape forms, which are more obviously derivable by variation and selection from the European and Indian Floras than the Australian endemic ones are from the Indian and Antarctic.

L.—CLIMATE: AN INQUIRY INTO THE CAUSES OF ITS DIFFERENCES, AND INTO ITS INFLUENCE ON VEGETABLE LIFE. By C. Daubeny, M.D., F.R.S.

THE Natural History Society of Torquay having elected Dr. Daubeny an honorary member, he could not but accede to the request made to him by some of the members, that he should give them a few lectures during his stay in their neighbourhood last winter. This was very considerate and wise of Dr. Daubeny, for at little strain upon himself he was able at once to gratify and instruct his friends; as, indeed, we all of us ought to be willing to do whenever our turn comes round. But matters did not stop here, for at the special request of a Master in Chancery, as it would seem from the dedicatory inscription, the lectures were dispatched to the printers. The result is an octavo volume, published by subscription, of some 140 pages, bearing the title which heads this notice.

Our opinion is that these lectures, although well suited for their original purpose, were not worth printing. We observe nothing new of importance in them; little that is old put in a new light; and there are numerous inaccuracies scattered through the book which render it in no way creditable to the author, whose honoured name we regret to find endorsing so much questionable matter. The lectures are four in number. The first and second refer almost exclusively to Climate, and discuss the relations of temperature to latitude, actual and normal temperatures, local causes affecting temperature, a polar sea, probable greater preponderance of water during an early period of the earth's history, temperature of the soil, humidity, winds, ozone, and the like. Upon the author's general observations under these heads we have nothing to comment. In the third lecture an attempt is made to explain the influence of climate upon vegetation, wild and cultivated species being distinguished, and some little detail entered into with reference to some of the more important food-producing plants. Mr. Darwin's theory is of course referred to; Dr. Daubeny inclining to withhold his assent to the whole thing until some vast gaps, which he alludes to, are bridged over. The fourth lecture relates mainly to the power of man in modifying climate, whether for better or worse, and the subject of acclimatisation; winding up with a reference to the "combination of circumstances" which render Torquay suitable as a winter residence for invalids.

At the commencement of his third lecture, Dr. Daubeny speaks of all Flowering plants as being divided into those with one germinal leaf or cotyledon, and those with two. He goes on to say that these two classes present the most marked differences in their structure, growth and mode of flowering, and that "from a review of these differences it will be obvious, that whilst dicotyledons are, as a rule, best adapted for cold climates, monocotyledons are equally so for warm ones." The differences in structure which generally obtain between dicotyledons and monocotyledons, it is true, are usually very marked; but these differences are by no means of either the kind or extent Dr. Daubeny here endeavours to make out. The excuse may be offered that his explanation was not intended for a scientific, but for a general audience. But this will scarcely serve to palliate the gross inaccuracy of his statements, which run thus:—"Dicotyledonous plants, such as those which constitute the forests of this and other moderately warm climates, consist of a series of concentric layers of wood and bark, between each of which we may suppose a stratum of confined air to be interposed." And, "monocotyledonous trees, of which palms afford us the most familiar examples, consist merely of one hard concentric layer of ligneous matter, inclosing a soft pulpy substance, full of juice." Dr. Daubeny says it cannot "be wondered at that they (Dicotyledons) should be tolerant of cold, both when we consider the slowly conducting power of dry wood of all descriptions, and also that of the air detained within the interstices of the timber itself." Were the structure of these two grand types what they are here represented, we might indeed be willing to grant, as consequent on such structure, that Dicotyledons "should be tolerant of cold," while Monocotyledons, might be, on the other hand, "very susceptible of freezing." But since Dicotyledons do not consist of concentric layers of wood and bark, with a stratum of confined air interposed between each of them, but of concentric and continuous layers of wood enclosed in a layer of bark, organically continuous, and without the interposition of any air-stratum whatever between any of the layers, we fail to find the structural advantage they possess, which would lead us *à priori* to the conclusion that these plants were specially fitted for cool and moderately warm climates. Dr. Daubeny, we think, leaves it to be inferred that Dicotyledons especially affect such climates, which is very far from being the case, An infinitely greater number of the giants of tropical forests are Dicotyledonous than Monocotyledonous. With regard to the comparative rarity of Palms beyond the tropics, it is true they do occur only as stragglers in cool climates, but we cannot conceive that the internal structure of their stems has anything whatever to do with determining the limit of their distribution. The circumstance of their growing usually with a single, exposed, continuously unfolding terminal bud might perhaps be alleged as one reason why a warm climate is needful to them, but the difficulties of predicating, on structural data, the capabilities of plants in respect to climate, and the inconsistencies in which we get involved when we attempt it, are such that, excepting in cases to which familiar physical causes directly apply, we think, in the present state of our knowledge, speculations of this kind are quite useless. What notion the members of the Torquay Natural History Society retain of the internal structure of Palm-stems it is difficult to say. Dr. Daubeny's account of them applies much better to Tree-ferns, or indeed to young branches of the Elder. The "marked difference" in the mode of flowering of Dicotyledons and Monocotyledons does not appear to be explained.

The lecturer goes on to say "that of the Dicotyledonous trees, which belong to temperate regions, those which extend farthest to the north are either protected from cold by numerous layers of bark, as is the case with the Birch, or else are provided with juices not susceptible of freezing, such as the essential oil, which occupies the so-called turpentine-vessels found in the bark and wood of the Coniferae." This is very bad. The essential oil is a secretion, usually confined to distinct reservoirs, and not a juice or sap. The layers of birch bark may be thick enough 'to hold water' for household, but certainly not, we think, for Dr. Daubeny's theoretical purposes.

An endeavour is made to show that "herbaceous plants, whose roots sink very little below the surface, will be ill adapted in general for either extreme of climate, flourishing neither amongst the frosts of the polar regions, nor yet amidst the scorching heats of the tropics." We very much need statistics upon the relative proportions of herbaceous and ligneous species in different Floras. The most *woody* Flora which has specially engaged our attention is, we think, that of Japan, where the climate is neither tropical nor arctic, and yet where we reckon ligneous species to form nearly 40 per cent. of the whole. It may be borne in mind that Palms, an eminently tropical group, form no tap-root.

With regard to the food afforded by species of *Manihot* in South America, Dr. Daubeny refers to but one species, though in his list of "additions, &c.," he speaks, on the authority of the Archbishop of Dublin, of another variety. Two species, *Manihot Aipi* and *M. utilissima*, the former sweet, the latter bitter Cassava, are described, with their respective varieties, and figured by Pohl, in his "Plantarum Brasiliae Icones, &c." Tapioca, Dr. Daubeny states to be the same as Cassava; that it is the name under which the latter is imported into Europe. We have always understood differently; that the fine starch, from which the Tapioca is ultimately prepared, settles down from the water in which the Cassava is washed.

Dr. Daubeny states that in Norway Wheat is cultivated as high as Drontheim, in lat. 59° ; in Sweden up to the 63° parallel. It would be remarkable were the western limit the lower, with the influence of the Gulf-stream so directly playing upon it. But Drontheim is in latitude about 63° 25′ according to our best Norwegian map, and Schübeler gives the northern limit of Wheat in the map accompanying his interesting "Culturpflanzen Norwegens" at 64° 40′. The same botanist gives the northern limit of Rye in Norway at 69° 30′, of Oats at 69°.

Who are the Messrs. Favre and Goudin referred to at page 100, as in contradiction upon the transformation of *Aegilops* into Wheat? We presume Fabre and Godron. Dr. Daubeny does not venture, he says, "to bring forward the case of the *Aegilops* as affording any independent support to the doctrine of Darwin regarding the gradual transmutation of species, although those who are already persuaded of the truth of that hypothesis, may feel themselves justified in interpreting the facts observed by M. Favre in accordance with it." It is much better, we should say, that he does not venture, for, writing with some specimens of M. Fabre's *Aegilops* and *Triticum* before us, we cannot think there can be much doubt but that M. Godron, confirmed as he has been by Planchon and others, is right in regarding the connecting links as hybrids.

Some of the author's observations in his fourth lecture upon the "sense in which the term acclimatisation can be applied to the vegetable kingdom," appear to us very sensible, and at the present time opportune.

A list of plants, too tender to be grown in the open air in the Botanical Garden, Oxford, but which bear exposure in the Scilly Islands, or near Falmouth, is given in an appendix; also a list of plants killed or affected by the winter of 1860-61 in the Oxford Garden.

Should a second edition of these lectures be called for, we trust that Dr. Daubeny will not let them go to press without revision and amendment.

LI.—CONSIDÉRATIONS SUR LA MÉTHODE NATURELLE EN BOTANIQUE. By P. Parlatore. Florence. 1863.

WERE it not that we personally know Professor Parlatore to be a most good-natured and harmless man, we should have set him down at once, on the first glance through this *brochure* of his, as a dangerous character and not to be trusted with a dissecting knife; for any one now-a-days professing himself a thorough-going reformer, whether in the scientific or political world, we are naturally prone to suspect. On going through the pages of this essay more carefully, we are surprised to find that the author has found time to devote himself to what is of so little practical use, while the elaboration of the Conifers for the Prodromus, and of his valuable "Flora Italiana," might have employed him with much greater advantage to the botanical world as well as to himself.

We believe that Parlatore seriously thinks that he is laying the foundation of a Natural Method, "qui restera toujours dans la science"! It has been growing upon him for a long time that botanists are all in the wrong, or, at any rate, only partially in the right, in the matter of their so-called Natural System. One and twenty years ago he began to be dissatisfied with the recognised principles upon which the Jussieuan and De Candollean systems are based, imagining that botanists depended too exclusively upon single characters, or characters afforded by single sets of organs. And this is the burden of his complaint, some seventy pages through. But every one else complains of the same thing, and every one, at the same time, drifts into the same abuse. Altogether we are in a pretty kettle of fish, and the water is getting warm, but as by jumping out of it we should only fall into the fire, we prefer simmering a little longer. After all, the disturbance which Prof. Parlatore threatens us with is not so fundamental. Like a sound Chartist he holds by five points, types as he terms them. Here they are—"These general types," he says, "of plant-structure are, in my opinion, five in number. 1st. The type of Cellular plants; 2nd. of Fibro-cellular plants; 3rd. of Vascular Cryptogams; 4th. of Monocotyledons; 5th. of Dicotyledons."

Our readers will see that, excepting the clumsy distribution of the Acotyledons, Prof. Parlatore's plan is that which is almost universally acknowledged and adopted. The term Acotyledon he drops, the character which it involves being negative. His third type of the Vascular Cryptogams includes, curiously enough, Characeae; a set of plants in which we imagine the 'vascular' element must be very difficult to make out. His use of the words Mono- and Di-cotyledons is under the special protest, which few botanists would think it worth the while to enter, that in employing these terms he does not wish it to be implied that he attaches exclusive importance to the presence of but one or two Cotyledons in the embryo of the respective groups, but that he has a regard to the entirety of their organisation.

It does not appear to be necessary here to enter into any further detail as to Prof. Parlatore's views. Upon the whole we may say that we very fully coincide in them, as indeed we suppose nearly all botanists must do. But we cannot grant that our systematists have been so 'artificial' in their practice, and so contracted in their conception of a truly natural method as Parlatore would make out in his account of the progress of philosophical system from the days of Cæsalpinius, Morison, Ray and Gesner to the present age.

In a foot-note we observe the following reference to the Darwinian theory of the origin of species by variation and natural selection: "Le lecteur comprendra que je ne partage pas cette théorie, que je considère comme une hypothèse très ingenieuse, mais qu'à mon avis nul fait constaté peut démontrer comme vraie."

Professor Parlatore's little book is dedicated to M. Ad. Brongniart, of the Institute, &c. &c.

LII.—FLORA ODER ALLGEMEINE BOTANISCHE ZEITUNG, HERAUSGEGEBEN VON DER KÖNIGL. BAYER. BOTANISCHEN GESELLSCHAFT IN REGENSBURG. Neue Reihe, XX Jahrgang. Regensburg, 1862.

MANY interesting papers on the Cryptogamia appear from time to time, in the periodical named at the head of this article, and the completion of an annual volume is a convenient period for a survey of the contributions which its pages afford to the advance of Cryptogamic Botany. In the present volume, we find that, with the exception of a catalogue of the Mosses of New Granada by Hampe, and a short paper by Lindberg, upon the presence of æthereal oils in some liverworts, the papers on Cryptogamic Botany are confined entirely to the Lichens.* The nature of the first of these papers, "Summa lichenum coniocarporum," by Trevisan, is shown by its title, and for the details of it we must refer our readers to the paper itself. Some others have only a local interest and do not require any special notice, but the occurrence of *Ricasolia Wrightii* Tuck., a Japan species, in the Bavarian Alps, near Berchtesgaden, is worth mentioning as a fact in botanical geography. It is possible the plant may be met with in other parts of Europe, but it cannot be common, as the thallus being a foot in diameter, it is impossible that it can be overlooked, although it may have been confounded with *Ricasolia herbacea.*

Into the personal controversy between Nylander and Fries, and between the former and Stizenberger, we have no inclination to enter, and regret that in their present style they should be allowed to carry it on in the pages of the Flora. Dr. Nylander's other papers, however, will be read with interest.

The one entitled—

"Quænam sunt in Lichenibus sporæ maturæ," (which should be read in connexion with a subsequent one, "Circa variabilitatem sporarum in Lichenibus notula,") is a complaint against the writers of the Massalongian School, for speaking of mature and immature spores. Dr. Nylander contends that it is impossible, for descriptive purposes, to draw any definite line between mature and immature spores, maturity being a status to be tested only by capacity for germination. He states, that the only determinate stage of evolution of the spores, is when emerging from the state of protoplasm they become free within the asci. He says, "Sporas juveniles vel plus magis evolutas "dico, secundum evolutionis gradum quem præbent vel secundum "ætates earum diversas, nunquam autem de sporis maturis vel im- "maturis loquor." In strictness, Dr. Nylander is perhaps correct, although the Massalongians would doubtless retort that whether spores are spoken of as "immaturæ," or "maturæ," or as "juveniles," or "magis evolutæ," is little more than a verbal dispute. With regard to the words "sporoblastæ" and "sporidiola," we agree with Dr. Nylander in considering them unfortunate terms, but although he is probably right in regarding these organisms as mere oil-drops, we think they are more constant, and of more systematic value than he seems disposed to admit.

In the "De momento characteris spermogoniorum notula," Dr. Nylander calls attention to the importance of examining the spermogonia, instancing an error into which he had himself fallen, in uniting the species *Physcia adglutinata* Flk. with *Physcia obscura*

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* We should mention, however, that the volume contains reviews by Dr. De Bary, of the recent works on the Myxomycetes, and on the investigations of M. Pasteur.

Ehrh. whereas the difference in the spermatia is so marked, as to leave no doubt of the two being distinct. This "notula," as well as a subsequent one, "De gonidiis Lichenum observationes quædam," contains some remarks upon the distinction between "gonidia" and "granula gonima," and upon the importance of the former with regard to the systematic position of the Lichens as a body; the conclusion which the author draws, being that the latter are inferior to the Algæ, where the "elementa gonidialia" abound, and superior to the Fungi where these elements are altogether wanting.

The next paper we have to notice, is one by Dr. Schwendener, on the development of the apothecia of *Cœnogonium Linkii*, and is important, as contradicting Karsten's hypothesis, with regard to the process of impregnation in this Lichen. At the end of his essay on parthenogenesis, Karsten added some observations on the development of the apothecia of *Cœnogonium*, which, if correct, showed that the latter originate in a free central cell, contained in an organ similar to the archegonia of the higher cryptogams. This central cell was stated to be impregnated in a manner almost exactly similar to what occurs in *Coleochæte* and *Saprolegnia* amongst the Algæ. If Karsten's observations were to be relied upon, the great problem of sexuality in the Lichens would have been solved, for it could hardly be doubted that what was alleged to have been seen in *Cœnogonium*, would speedily have been discovered in other Lichens, when observers were put upon the track. Karsten's observations, however, have not been confirmed by any other botanist, and Dr. Schwendener meets them with a positive contradiction. We strongly recommend a careful perusal of Dr. Schwendener's paper, where details will be found, of which, without figures, it is impossible to give a full account. There are some remarks at the conclusion, which well deserve the attention of Lichenologists. The author says, "Whether the "mother-cells of the spores or some other cells are impregnated, is "a question still unsettled, and which will probably occupy many an "observer, until the right solution is arrived at. As matters stand "at present, however, the assumption of an impregnation of the "young asci is the most probable one. It is easily seen that in many "apothecia, tolerably wide canals lead down from the upper surface of the *Lamina proligera* to the apex of the asci, and more-"over, that the membrane of the older asci exhibits at this spot "(which is usually thickened and gelatinous,) a pore, which traverses "the inner layers, extending often as far as the so-called primary "membrane. May it not be suspected that these circumstances have "some connexion with the impregnation?"

The only remaining paper which we have to mention, is one by Dr. Stizenberger, entitled "Ueber den gegenwärtigen Stand der Flechtenkunde." It contains a useful sketch of the progress of Lichenology during the last few years. The author remarks, that the principal discoveries relate to the organs of impregnation, the structure and development of the thallus, and the geographical distribution of Lichens. Whatever may be the case with regard to the two latter points, we cannot think that much has been done in the matter of the organs of reproduction. No doubt Tulasne's demonstration of the prevalence of spermogonia was of great importance, but it is quite premature to speak of these organs, (as Dr. Stizenberger does,) as "männliche Befruchtungsorgane," and indeed we believe that this view of their function is doubted, even if it has not been abandoned by Tulasne himself.

Dr. Stizenberger gives a short sketch of the different systems, placing Nylander's and Körber's arrangements (which he calls thallistic (thallistischen) systems,) in opposition to those of Nägeli, Berkeley, Theodore Fries, and Massalongo, which he calls carpological. It seems an error to call Berkeley's system "carpological," at least in the sense in which that word would be applied to the arrangement of Massalongo. A system in which Lichens are divided into "angiocarpi" and "gymnocarpi," may have very little in common with a system in which genera are founded upon distinctions existing in the sporidia, and to which alone the definition "carpological" can be properly applied.

LIII.—JAHRBÜCHER FÜR WISSENSCHAFTLICHE BOTANIK. HERAUSGEGEBEN VON DR. N. PRINGSHEIM. Dritter Band. Zweites Heft. Berlin, 1862.

In the able periodical mentioned at the head of this article, as well as in the Botanische Zeitung of Berlin, and the Regensburg Flora, a large proportion of space has always been, and still is, devoted to Cryptogamic Botany. The family of the Algæ has hitherto received the most attention in Dr. Pringsheim's book, a circumstance by no means to be regretted, as the Lichens are carefully looked after in the "Flora," and the Botanische Zeitung divides its favours pretty equally amongst all the Cryptogamia. In the part of the above work which is now before us (Vol. 3, Part 2), we find three papers, to which we wish to direct the attention of the readers of this Review. The first is by Dr. Hofmeister, the second by Dr. Pringsheim, and the third by Professor Cienkowski. Dr. Hofmeister's paper is entitled "Zusätze und Berichtigungen zu den 1851 veröffent- "lichten Untersuchungen der Entwickelung höherer Kryptogamen." It is not necessary, as far as English readers are concerned, to do more than to mention the title of this paper, as the "additions and corrections" referred to have been embodied in the Ray Society's English Translation of the new MS. edition of Dr. Hofmeister's work. In the present paper the author has afforded to the botanists of Germany an opportunity of studying these additions and corrections in their own language.

The second paper above alluded to is one by Dr. Pringsheim, the title of which is as follows: "Ueber die Vorkeime und die nacktfüssigen Zweige der Charen," which may be anglicized thus—"On the proembryos and the barefooted shoots of the Charæ." We feel rather inclined to take exception to the use of the word "nacktfüssigen," for when the organs in question come to be described, it would seem that "nacktbeinige" (or whatever may be the proper German word for "bare*legged*") would be more applicable than the word "nacktfüssige;" but these remarks might be objected to as hypercritical.

With regard to the word "Vorkeim," or "pro-embryo," we consider it decidedly objectionable. The new plant (as will be seen from what follows) is produced by gemmation, and not from an embryo. In fact, the embryology in Chara is at present quite obscure. It is known that the so-called globules (or antheridia) contain spermatozoa, and it is suspected that the latter obtain access to the central cell of the nucule, and impregnate it; but the process of impregnation has not been observed, nor is there known to be any alternation of generation, as in Ferns and Equisetaceæ. To speak of the "pro-embryo" of a plant, in which nothing answering to an embryo is known, is certainly a misnomer.* For the purposes of this paper, however, we must continue to use the word, subject to the above protest.

It is well known that in the Mosses and Liverworts the so-called proembryo is a confervoid process, which precedes the formation of a new plant, whether such new plant is produced by a germinating spore, or from a cell of an existing plant. The proembryos of Mosses have been admirably described and figured in Schimper's work, "Recherches sur les Mousses," published in 1848, and some observations upon those of Liverworts are to be found in Bischoff's Handbuch der botanischen Terminologie, in the Botanische Zeitung for 1853, p. 113, and in the same journal for 1858, Supp. p. 45. No organs of this nature have hitherto been known to exist in the Charæ, which have been supposed to occupy a sort of isolated position, which has been thus described by Bischoff, who says, "It is clear "that in the Charæ the germ-plant is developed immediately from "the spore, without a trace of a primitive germ-organ as is the case "with the other cryptogams of the higher orders, and thus the "position of these plants on the dividing line of the two principal "divisions of the vegetable kingdom is established."

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* Dr. Hofmeister, in his work on the Higher Cryptogamia (see Ray Society's Translation, p. 171, note), says:—"I wish to add a few words as to the meaning "of the expression 'pro-embryo.' By the word 'embryo' is meant the bud capable "of developing leaves and roots. Thus, we speak of the embryo of the onion, the "potato, the hop. Now, when we find in the vegetable kingdom organs which differ from, and are of an essentially simpler structure than, the leafy stem-rudiments which afterwards spring from them, but which must normally and "necessarily in the course of their development produce embryos, I consider that I "am justified in calling these organs 'pro-embryos.' Thus I designate as a pro-"embryo the protonema of a moss, whether it owes its origin to the germination of "a spore, or to the independent development of an individual cell of the leaf-bearing plant. I treat in the same manner the suspensor of Selaginella, of the "Coniferæ, and of the Phanerogamia. On the other hand, I do not designate as a "pro-embryo the body which is produced directly from the germination of the "spores of Ferns, Equisetaceæ, Rhizocarpeæ, and Lycopodiaceæ, and which bears "antheridia and archegonia. . . . . I call this organ a prothallium."

Mr. Berkeley, in his recently published Handbook of British Mosses, says:—"The threads arising from the spores (of Mosses) have received various names, as "'cotyledonoids,' 'protonemata,' 'proembryo,' 'prothallus.' The first of these is "objectionable, because they have no analogy with true cotyledons, and the third "because an intermediate stage must take place before the cell capable of impregnation is produced in the archegon, the result of which, after all, is a sporangium, "and not an embryo. The production of the plant from the threads is rather gemmiparous than embryonic, and I therefore strongly object to the term 'proembryo,' "which inevitably more or less directly leads to confusion. The second name at "least is free from error; and if the moss plant may be called a 'thallus,' the fourth "name may be admitted. If new terms were not objectionable, I should prefer "that of 'prophyton,' which simply indicates that it is the forerunner of the true "plant."

We will now proceed to give a concise summary of Dr. Pringsheim's observations, which embody the interesting discovery that the Charæ do not occupy the exceptional position assigned to them by Bischoff, but produce proembryos like the Mosses and Liverworts.

The germination of the spores of Charæ was first observed by Vaucher in 1821, and afterwards noticed independently by Kaulfuss. Bischoff was the first who distinctly maintained (in the passage quoted above) that in Chara the germ-plant arises directly from the spore without any preceding germ-organ, and that Chara therefore differed from the other higher cryptogams. This Dr. Pringsheim maintains is an erroneous view, for he says that in Chara also a *proembryo* is first formed, from which the new plant is produced by a process of gemmation.

The observations leading to this conclusion were made principally upon *Chara fragilis*. In young plants of this species, growing under ordinary circumstances, there is normally only one lateral shoot in the axil of the oldest leaf, which shoot differs in no respect from the mother-shoot. But in older plants, especially if they have lived through the winter, shoots are formed not only in the axil of the oldest leaf, but also in the axils, and at the base, of the younger leaves of the same whorl. These latter shoots are more or less abnormal, and of two kinds: they are called by Dr. Pringsheim respectively "barefooted shoots" (nacktfüssige Zweige), and "proembryonal shoots" (Zweigvorkeime). The abnormalities of the former are—a want of bark* (occurring usually only in the lowest joint);—often an entire suppression of nodes in the leaves, especially of the first whorl;—occasionally a variableness in the size and number of the internodes of the individual leaves of the first whorl. Great variations, however, exist in the features of the barefooted shoots, and several special instances are mentioned. It is not necessary to notice them here, nor indeed are the barefooted shoots generally of much importance, for Dr. Pringsheim himself admits that they are only ordinary shoots unessentially modified.

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* We have not space to go into the mode of formation of the cortical layer in Charæ; it is formed by strings of cells ascending and descending from the nodes and covering the axis.

The proembryonal shoots are of more interest. They appear to pass into normal shoots in their upper parts, but are quite irregular below. Every normal lateral shoot of *Chara fragilis* begins with a green joint exhibiting the characteristic rows of chlorophyll, and bears immediately above it the first leafy node. The proembryonal shoots on the other hand begin with a colourless joint, followed by a deficient and leafless node, which is sometimes wanting, sometimes replaced by an elongated cell. Next comes a naked joint, bearing apparently the first whorl of leaves, but this whorl is remarkable from having one (apparent) leaf developed far more than the others, and to an extent never seen in a normal shoot. From this point the shoot becomes normal; that is to say, its subsequent internodes, nodes, and leaves are like those of ordinary shoots, leading to the supposition that the normal shoot originates laterally in the axil of the abnormally developed (apparent) leaf* abovementioned. This pseudo-leaf does not proceed from the 2- or 3-celled node beneath it, for observation shows that the latter is not formed until after the pseudo-leaf has begun to be developed. Dr. Pringsheim, therefore, arrives at the following conclusion. He says, "it is clear therefore " that the terminal process before-mentioned is not a leaf, but the " apex of a special organism having a very simple law of growth. I " call this organ a proembryonal shoot (Zweigvorkeim), because the " first bud of the normal shoot is subsequently developed at a definite spot on this proembryonal shoot, and because the latter exactly " resembles the proembryos which are produced in the germination " of Chara-spores, and on which, in like manner, the first leafy shoots " of the Charæ are produced from subsequently-developed lateral " buds."

Tracing the proembryonal shoot from its commencement, its history (setting aside occasional irregularities not essential to be here noticed) is as follows. A cell is protruded from the node of an old plant, which cell elongates and has its apex cut off by a transverse septum. The division of the terminal cell is repeated several (3-6) times, and thus the pseudo-leaf, or proembryo-apex (Vorkeimspitze), above mentioned is formed. In the meantime the elongated cell swells up close underneath the pseudo-leaf, and the enlarged portion is cut off from the part beneath it and becomes a special cell, which the author calls the bud-base (Knospen-grunde). Two new septa, *not parallel to the former septa*, are formed in this special cell, which thus becomes divided into three cells, of which the lower one divides and forms a sort of node, the middle one divides no more, and the upper one becomes a vegetative cell, protrudes itself laterally, and eventually forms the first leafy shoot. This protrusion is effected by a one-sided growth of the lateral surface of the vegetative cell, similar to what takes place in the ramification of Confervæ, and, looking down from the top of the pseudo-leaf, the protruded part is seen projecting beyond the base of the latter. The vegetative cell, having thus protruded itself, gradually assumes an upward growth, by which the pseudo-leaf is pushed a little aside from its originally terminal position, and the basal wall of the vegetative cell becomes inclined. During this growth the vegetative cell divides (according to the normal mode of division of the vegetative cells of Chara-shoots) by septa at right angles to the line of growth: the direction of this line gradually changes from a horizontal to a vertical one, and the position of the successive septa changes with it, the first being vertical or nearly so, the second somewhat inclined, the third more so, and the horizontal position being usually attained by the fourth.

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* Hereafter, for convenience, we will call this organ the "pseudo-leaf." It is the apex of the proembryonal shoot, but is not, according to Dr. Pringsheim, a true leaf.

The first three of the cells formed by these septa lie almost entirely or for the most part underneath the base of the pseudo-leaf. Their nature is peculiar, and without diagrams it is impossible to enter into the details of their subsequent growth. We can only state generally that they become immediately transformed into imperfect nodes, the peripheral cells of which grow out and form imperfect leaflets; and thus the growing apex of the vegetative cell becomes surrounded by a circle of leaf-like organs, which do not all spring from the same node, and which are of different sizes, the pseudo-leaf itself being the largest of the whorl.

It would occupy too much space to enter into any particulars of the abnormalities and monstrosities which have been observed to occur in the pseudo-leaf and other organs above described; but Dr. Pringsheim's remarks upon the germination of the spores must not be passed over.

It has been observed that the germinating spore produces what the author calls a proembryo, from whose leafless nodes (as in the case of the proembryonal shoots) the leafy shoots are afterwards produced. This proembryo is terminated by a pseudo-leaf; its first node produces a number of barefooted shoots, and in short it resembles substantially in every respect the pro-embryonal shoots above described.

We have thus endeavoured to give, as concisely as was consistent with clearness, the main results of Dr. Pringsheim's observations: they will be of great interest to cryptogamic botanists, and embody a discovery of considerable physiological importance. The obvious conclusion deduced by the author is that a close relationship subsists between the Charæ and the Mosses. He says: "In addition to the " form of the spermatozoa and of the rudiments of the fruit, in " which the Charæ come so near to the Mosses, there is now to be " added the similarity in the origin of the leafy shoots from buds " which are produced upon confervoid leafless proembryos." And again: "The complete morphological correspondence between the " proembryos of Charæ and Mosses is manifested most clearly by " the proembryonal shoots of the former. For amongst all leafy " plants it is only on the stem and leaves of Mosses that we find "organs analogous to the proembryonal shoots of Charæ. . . . . "The Charæ, therefore, in their general development, pass through "the same stages as the Mosses. They are leafy plants without "main-stem or main-root, their branches, as in the Mosses, originating laterally either upon other leafy branches, or upon leafless "pro-embryos." After noticing the points of difference exhibited by the Charæ and Mosses in the structure of their antheridia and the formation of their fruit, Dr. Pringsheim concludes that the former must be ranked as a special group of the Muscales, and he adds that the discovery of the pro-embryos shows that the Charæ, as well as the Ferns and Mosses, are subject to what seems to be a general law, viz., that in all leafy plants the spore can never become directly transformed into the vegetative apex of the leafy axis.

We have but little space left to notice Professor Cienkowski's paper. It relates to the much-vexed question of the systematic position of the Myxogastric fungi, and is entitled "Zur Entwickelungsgeschichte der Myxomyceten."

The results of the author's observations are :—1. That what he calls the Plasmodium, *i.e.*, the motile protoplasmic mass of the Myxomycetes, is naked (hüllenlos), and consists of two substances, the one, hyaline, highly extensible and contractile, the other fluid and granular. 2 That contractile Vacuoles are present in the hyaline substance of the plasmodia, in the cells out of which the latter originate, as well as in the amœboid bodies which are formed from the latter cells, and which the author calls Myxo-amœbæ. 3. That the plasmodia, especially the Myxo-amœbæ, take in foreign bodies, as the Amœbæ do. 4. That the plasmodium originates in the gradual amalgamation of the Myxo-amœbæ. 5. That two plasmodia of different genera of Myxomycetes never amalgamate.

Professor Cienkowski is of opinion that the Myxomycetes are closely allied to Amœbæ, Monads, &c., but that the answer to the question whether they are animals or fungi, depends more upon the observer's philosophical ideas than on facts. We do not feel disposed to discuss the question here. It is at present a mere matter of speculation, although we cannot but agree with M. Tulasne, who considers it "contra omnem verisimilitudinem,"* that their nature should be animal. A paper lately read before the Linnean Society contains some observations on the germination of *Cribraria intermedia*, which, if correct, show that the germination in that species of Myxogaster is by filaments, as in the case of ordinary fungi, a fact strongly opposed to the views of those who look upon these organisms as animals. Those who take an interest in the controversy, should refer to some recent papers on the subject, published by Dr. de Bary, in the Regensburg Flora for 1862, where that able naturalist, after reviewing the late works on this subject, maintains his former opinion, that the Myxogasteres must be excluded from the vegetable kingdom.

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* See Selecta Fungorum Carpologia, c. 1.

LIV.—WEST-INDIAN HERPETOLOGY. BIDRAG TIL DET VESTINDISKE OERIGES OG NAVNLIGEN DE DANSK-VESTINDISKE OEERS HERPETOLOGIE, AF J. Reinhardt og C. F. Lütken. Naturhist. Foren. Vidensk. Meddelelser for 1862.

IN the excellent Report on the recent progress and the present state of Ornithology, presented by the late Mr. H. E. Strickland to the British Association in 1844, it is well remarked that "the Natural History of the West Indies is far less known than from the long connection of these islands with Europe might have been expected," and with regard to the smaller islands of the group it is further stated that they have been "neglected by Naturalists. But few of their natural productions ever reach our Museums, and then are too often consigned to the cabinet without being scientifically described or published."*

Such was the case in 1844, and although the additions that have been made to our knowledge of West Indian Zoology during the nineteen years which have elapsed since that period, have been neither few nor unimportant, we cannot but think that Mr. Strickland's language is equally applicable to the present state of the case. Specimens of Natural History from the greater Antilles are still deficient in most of the Museums of Europe, and as regards many of the smaller islands their indigenous animals are still altogether unknown.

As regards the Mammals and Birds of the West Indian Islands generally, we are not aware that anything like a general systematic account has ever yet been attempted of this part of the Fauna. And the essay on the Herpetology of this region, by Messrs. Reinhardt and Lutken, the title of which we give above, rather tends to show the poverty of our present knowledge of this subject than the extent of the advances that have been lately made. It is only recently that Naturalists have commenced to realize the importance of obtaining accurate information relative to the *exact* localities of animals. "South America," "Africa," or the "South-sea Islands" were, until lately, the sort of "*habitats*" too often affixed by describers to their specific characters of animals, and, as far as one can understand, frequently without any idea that the knowledge of more circumscribed localities was in any way desirable. Now the chief interest of the West Indian Fauna consists in the fact of the different islands possessing peculiar species. And until each island-fauna has been investigated and its relations to its neighbours accurately worked out, our knowledge of that Fauna cannot be assumed to be complete, although we may be already acquainted with the whole of the West Indian species, and not a single new form may remain among them to be introduced into our scientific catalogues.

The materials employed by Messrs. Reinhardt and Lutken, for the purposes of their present paper, have been chiefly collections in the Royal and University Museums of Copenhagen, from the Danish Islands of St. Thomas, St. Croix, and St. John, of which the principal contributors have been Herr Apotheker Riise, a well-known resident at St. Thomas', Prof. Oersted, and Dr. Hornbeck. There are also specimens of Reptiles in the above mentioned Museums from the islands of Cuba, Haiti, Jamaica, Porto Rico, Martinique, Trinidad, and other smaller islands, collected and presented to these institutions by Dr. Riisse, Lieut. Koch and others, which have been likewise carefully examined. Our authors have also consulted with special reference to the Antillean Fauna, Duméril and Bibron's "Erpetologie," Daudin's "Reptiles," Ramon de la Sagra's "Cuba," Gosse's "Naturalist's Sojourn in Jamaica," Hallowell's and Cope's articles in the "Proceedings of the Academy of Natural Sciences of Philadelphia," and the Museum Catalogues of Duméril, Günther, Gray, and Lichtenstein. They acknowledge the probability of various errors in localities, but claim a general correctness for their catalogue of West-Indian Reptiles, so far as it is as yet known, as deduced from these authorities. The following table gives a summary of the species in each class of Reptilia, as shown by Messrs. Reinhardt and Lutken's catalogue:—

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* See Report of the British Association for 1844, pp. 194-5.

	Bahamas.	Cuba.	Jamaica.	Haiti.	Porto Rico.	Virgin Isles.	Carab. Isles.	Trinidad.	West Indies.	Total.
1. Batrachians	—	4	5	9	1	4	5	2	—	20
2. Ophidians	2	21	8	13	4	4	37	17	14	96
3. Saurians .	3	31	22	17	3	19	34	8	10	114
4. Crocodilians	—	2	1	1	—	—	3	2	—	4
5. Tortoises .	1	7	6	1	1	5	5	—	—	14
	6	65	42	41	9	32	84	29	24	238

With reference to this list we must remark that the greater number of the species have not been personally examined by the authors themselves. As far as this has been done it may no doubt be relied upon. But such is the carelessness about localities that has hitherto, as we have already stated, generally prevailed; and such indeed is the carelessness with some naturalists, even of the present day in the same matter, that it must be manifest that many reptiles are inserted in the above list that have no real claim to a place in the Fauna of the Antilles. It would have been almost better perhaps if Messrs. Reinhardt and Lutken had altogether excluded from their list every species that they had not personally examined from an ascertained locality, for though their list would have been thus fearfully reduced, they would have had a certain basis of truth to reason upon when considering the general aspects of the Reptilian-Fauna of the Antilles. Nevertheless it is, of course, very convenient for future workers to have collected into one list all the species that have been *stated* by divers authors to have occurred in the West Indies.

As regards the Batrachians of the Antilles, with which Messrs. Reinhardt and Lutken commence their list, the division of their Neotropical Region appears to produce no genera, absolutely confined to these islands. But *Hylodes* and *Trachycephalus* are forms which are highly characteristic of this Fauna, each of them being represented by several species, and being of less common occurrence on the South American continent. We may also notice as remarkable the entire absence, so far as is hitherto known of true *Hyla*, an almost cosmopolitan form, and one which is well represented both in North and South America.

Amongst the Venomous Serpents of the Antilles the most remarkable is certainly the *Bothrops lanceolatus*, called the Rat-tail in Santa Lucia, and the Fer de Lance, in Martinique. This much dreaded scourge of the inhabitants of these islands is stated to occasion an average of twenty deaths yearly in Santa Lucia alone, and to maim or dangerously wound 180 other human beings. It is commonly said that one cannot walk ten yards off a road without being bitten.* A special work has been written on its history and noxious qualities,† and the Society of Acclimatation of Paris has established a special prize of 1000 francs to reward the introduction into the island of some animal that will destroy it.‡

Amongst the Colubriform Serpents *Dromicus* is perhaps the most characteristic Antillean genus, the majority of its species being found there.§ But *Hypsirhynchus* is peculiar to the Antilles, and no less than three generic forms, *Arrhyton*, *Cryptodacus* and *Urotheca*, are, as far as is hitherto known, quite confined to Cuba. Four genera of *Boidæ* (*Ungalia*, *Homalochilus*, *Chilobothrus* and *Notoptolis*) are likewise peculiar to the Antilles, whilst *Boa* and *Epicrates* are shared with the adjoining continent of South America. *Anolis* is certainly the genus of lizards most abundant in the West India Islands, but it likewise occurs in Central and Southern America. Upwards of forty described species of this genus are inserted in Messrs. Reinhardt and Lutken's list, but the group must pass the ordeal which it is now undergoing beneath the critical revision of Dr. Peters and Mr. Cope before all these species can be accepted as valid. Another highly characteristic group of Lizards of the Geccoid group in the

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* Trollope's West Indies, &c.

† Enquete sur le Serpent de la Martinique. Par le Dr. E. Rufz. 2nd edition. Paris, 1859.

‡ Since the introduction of the sugar-cane into Martinique the European Brown rat (*Mus decumanus*) has become very abundant, that Rodent being much given to sugar cane as an article of diet. The *Bothrops* has found the Brown rat a very suitable prey, having been in former days rather stinted for food, and has consequently greatly increased in numbers. It is now proposed to introduce the Secretary-bird of Africa (*Secretarius reptilivorus*) in order to stop the ravages of the serpent.

§ Including *Alsophis* in the same genus nineteen species of this form are enumerated in Messrs. Reinhardt and Lutken's list.

Antilles is *Sphæriodactylus*, of which eight species are West Indian. The rest are mostly Neotropical forms. The Crocodilians and Tortoises, as far as is hitherto known, are not represented in the Antilles by any very strongly marked forms.

LV.—ANNUAL REPORT OF THE TRUSTEES OF THE MUSEUM OF COMPARATIVE ZOOLOGY, CAMBRIDGE, U. S. A., TOGETHER WITH THE REPORT OF THE DIRECTOR, 1863. Boston, 1862.

WE have read with pleasure Professor Agassiz's Report for the year 1862, of the state of the new Museum of Comparative Zoology at Cambridge, U. S. A., whereby it appears that this youthful institution is "progressing," at a pace that is likely ere long to place it in advance of many of the rival establishments of the Old World. "Notwithstanding the distracted condition of the country," says the learned and patriotic Professor, "it is a source of great gratification to "me, and a sign of the unimpaired activity of our merchants in all parts "of the world, that I can announce the arrival during the past year "on board of merchant-ships, and mainly through the liberality "of gentlemen engaged in business, of no less than two hundred "and thirty packages, barrels, cans, &c., filled with specimens from "every quarter of the globe."

The class in which the new Museum seems to be richest is that of fishes, of which the enormous number of 100,000 specimens, representing nearly 6000 species, are stated to be in the collection. Speaking of this, Professor Agassiz says:—

"Thus far the collection of fishes brought together in the Jardin "des Plantes, by Cuvier and Valenciennes, has been considered the "largest in existence, numbering about 4,200 species, according to a "recent report by Professor Duméril. From a recent article in "the 'Natural History Review,' of London, I see that the Curator of "the British Museum claims now a superiority for their collection "over that of Paris, stating that the former contains 20,000 speci-"mens. The number of species is not given, but judging from Dr. "Günther's catalogue, as far as printed, the number of species can "hardly exceed that of the Jardin des Plantes. Our own collection "numbers now 100,000 specimens, representing 6000 species, all pre-"served in alcohol."

With regard to this, we may observe, that as regards the number of *specimens* of fishes, the Cambridge Museum unquestionably stands superior to any other, our National collection in the British Museum not being estimated to contain much more than 20,000 specimens. But we believe there is little doubt that the British Museum collection is richer in *species* than that of the Jardin des Plantes of Paris. Dr. Günther estimates the collection of fishes under his charge as containing between 5000 and 6000 species—it being impossible until the catalogue is finished to ascertain the number very exactly. Now, Cuvier and Valenciennes, it is true, may have registered 4200 species as described in their joint work, as being in the French collection. But it is now well known, that many of Cuvier and Valenciennes' species are fictitious, the same fish having been in many instances described under half a dozen or more different names. We believe, therefore, that there is no reason to doubt of the superiority of the British to the French collection in this class of animals; though, if Professor Agassiz's estimate of species at Cambridge be correct, both of them must yield the palm to their transatlantic rival.

Professor Agassiz is likewise satisfied, from the rapid examination he has himself made, of the Echinoderms and Corals in the British Museum and Jardin des Plantes, that the Cambridge collections of these classes are "inferior to none, even if they are any where equalled."

Original Articles.

LVI. — On the Molar Series of Rhinoceros Tichorhinus.

By W. Boyd Dawkins, B.A. Oxon., F.G.S.

Contents:

§ 1. Introduction.
§ 2. System of Measurements.
§ 3. Common Characteristics of Permanent and Deciduous Molar Dentition.
§ 4. Dental Formula.
§ 5. Characteristics of Permanent Upper Molar Series: — 1.—Pm 2. 2—Pm 3. 3—Pm 4. 4— M1. 5— M2. 6— M3.
§ 6. Characteristics of Permanent Lower Molars: — 1—Pm 2. 2—Pm 3. 3—Pm 4. 4—M 1. 5—M 2. 6—M 3.
§ 7. Characteristics of Upper Milk Molars:—1—Dm 1. 2—Dm 2. 3—Dm 3. 4—Dm 4.
§ 8. Characteristics of Lower Milk Molars:—1—Dm 1. 2—Dm 2. 8—Dm 3 and 4.

Figures of the Upper and Lower Milk Series, and of Pm 2.

§ 1. Introduction.—My object in the present communication is to reduce to some sort of order the classification of the Molar Series of *Rhinoceros tichorhinus*, and to define, as far as possible, each tooth from its homologues in other species. This I am able to do with considerable accuracy, by the application of a system of terms and measurements, that I have found invaluable, not only in the present instance but also in determining the more difficult Artiodactylian teeth, and by the characteristics which obtain in the large numbers that have passed through my hands. The generalizations are based upon a careful examination of seven jaws and upwards of 200 teeth, from Wookey Hole, of those in the British Museum, and the Museums of the Royal College of Surgeons, of the Geological Survey, of Taunton, and especially of Oxford. In mapping out the teeth, I have adopted Brandt's* nomenclature as far as possible, and all the more readily, as it coincides with a system of terms that I had used for some time before his monograph came into my hands.

§ 2. SYSTEM OF MEASUREMENTS. – The value of a system of measurements in accurately showing the relation of the parts measured to the whole tooth will be seen in its application in the following pages. As the crown varies in the relative size of its parts according to the state of wear, all the measurements are taken *along the base*, instead of the summit of the tooth. The four used below are numbered for the sake of reference, and will be referred to by the numbers at the beginning of each. All are taken in inches and tenths.

1. Antero-posterior measurement, taken along *the outside* of crown.
2. Antero-transverse measurement, taken across the anterior lobe of the tooth, from the middle of the anterior collis † to the middle of the anterior area, or at the neck of the anterior pair of fangs.
3. Postero-transverse measurement, taken across the posterior lobe of tooth, or at the neck of the posterior pair of fangs.
4. Circumference of base of crown.

§ 3. CHARACTERISTICS OF PERMANENT AND DECIDUOUS MOLAR DENTITION.—The Molar series of the upper and lower jaw are far more closely allied to each other than at first sight appears. Composed of the same elements, modified for a special purpose in each tooth, they possess a large number of common characteristics. The crowns are traversed by two depressions of variable depth, with their entrances either open, or more or less closed. Of these, the anterior, always opening upon the inner side, is the Anterior Valley [A of fig. 1—7]‡; the posterior opening on the inner side of the lower, and the inner and posterior angle of the upper molars, is the Posterior Valley [B of figures].§ In front of the Anterior Valley is the Anterior Collis|| [D], while between the two valleys, the Median Collis¶ [E] forms the posterior wall of the one, the anterior of the other. The Posterior Collis** [F], forms the

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* Brandt, 'De Rhinocerotis Antiquitatis seu Tichorini seu Pallasii structurâ,' etc. Trans. de St. Pétersburgh, Vol. vii. pt. 2. (4to. 1849.)

† *Vide* § 3.

‡ 'Vallis Anterior,' Brandt. 'Vallon Oblique' in the Upper Molars.—Cuvier.

§ 'Vallis Posterior,' Brandt. In the Upper Molars 'Echranchrure au bord Postérieur,' Cuvier. 'Fossette Postérieure,' Blainville.

|| 'Collis Anterior,' Brandt. In the Upper Molars 'Colline Seconde,' Cuvier.

¶ 'Collis Medius,' Brandt. In the Upper Molars, 'La Troisième Colline,' Cuvier. Christal.

** 'Collis Posterior,' Brandt. In the Upper Molars, 'Bord Postérieur de la Dent,' Cuvier. Blainville.

posterior border of the tooth, and holds the same relation to the posterior that the Median Collis does to the Anterior Valley. In the upper molars this typical arrangement is concealed by the great development of the Anterior Valley and the Median Collis, at the expense of the Posterior Valley and Collis, which are thrust, as it were, backwards, and excluded from a share in the inner surface of the tooth. The entrance of the Posterior Valley is also so close to the summit of the crown, that it is soon worn away, leaving the valley as an island of enamel, surrounded by dentine. A series of teeth in my possession shows the stages by which the typical form is obscured. In it the posterior island of enamel of the Premolars gradually increases in size from before backwards, through the large partially-open valley of $\underline{\text{m 2}}$ into the indisputable posterior valley of $\underline{\text{m 3}}$. Without this evidence, I should have hesitated in adopting Brandt's views of the homologies on the evidence he gives.

The external surface bears costæ (K), or ribs, more or less vertical, divided from each other by sulci, or grooves. The deepest and most persistent of these is the Median or *Master Groove* (I), dividing the surface vertically into two areæ (M. N.), the anterior and the posterior. The former of these always bears two costæ, which, in the lower molars, are sometimes nearly obsolete.

The enamel bears rough vertical rugæ, more or less developed, and never parallel. Besides these is a set of fine vertical and parallel striæ, which in the older teeth are almost obliterated by the more strongly-marked series. Also, and especially in the Premolars, is a third set of markings, linear, horizontal, and very superficial, only to be seen in the young teeth, and forming, with the two vertical sets, a faint reticulated pattern. In the milk molars, the first of these three series of markings is very fine, the second barely visible, and the third absent from all that I have examined.

§ 4. DENTAL FORMULA.—With reference to the number of the Permanent molar series dentition, the great authorities are by no means agreed. On the one hand, Cuvier, on the faith of a letter from Adrien Camper,* and after him Blainville,† maintain that *R. tichorhinus* has a full complement of Premolars; while, on the other, Pallas‡ and Fischer§ doubt it: and Brandt,|| after carefully weighing the evidence, concludes that the first Premolar is always absent from the adult. It must be remarked that neither Cuvier nor Blainville ever saw the first premolar, the existence of which they assume. Professor Owen, indeed, figures and describes¶ a tooth as being that in question, mistaking the deciduous for the permanent dentition in the two jaws from Thame and Lawford in the Oxford Museum. But,

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* Ossemens Fossiles, Vol. ii. Pt. I. p. 61, 1822. † Osteograph. Rhinoceros, p. 107.

‡ Novi. Comment. Petropol. Tom. xvii.

§ Fischer, Oryctographie de Moscou; p. 114.

|| Brandt. op. cit. p. 325.

¶ Brit. Foss. Mam. (1846), pp. 337—342, 363-4, Figs. 128, 137.

besides the points of difference to be noticed in treating of the Milk series [§ 8, 1], the fact that in both the jaws the fourth tooth is in place, while the alveolus behind it shows that the fifth, or m 1, was still in the gum, is a conclusive proof that the teeth they contain do not belong to the permanent dentition. For in the recent, as the fossil Rhinoceros m 1 is always in place a considerable time before Pm 4, and is always more worn.* Neither in the skulls at St. Petersburgh, ranging from young to old adults, nor in the jaws in the Oxford and British Museums, of all ages, is there the slightest vestige of Pm 1, but its place is represented by a rough crest, (cristula aspera of Brandt.) Nor in the four lower jaws, containing deciduous dentition, which I have sawn up, have I detected an alveolus or other trace of its germ. On the contrary, the fangs of the first milk molar, are so close together, and in stoutness and length so entirely different from the rest of the milk set, that there is very good presumptive evidence that in the lower jaw Pm 1 is not calcified even in the youngest Rhinoceros. The dental formula therefore, as far as our present knowledge goes, will be Dm $\frac{4}{4}$, $\frac{\mathrm{Pm}\ 3\ .\ \mathrm{m}\ 3}{\mathrm{Pm}\ 3\ .\ \mathrm{m}\ 3}$

§ 5. CHARACTERISTICS OF PERMANENT UPPER MOLAR SERIES.—The teeth of the Upper Molar series most difficult to be determined on account of the variable form of the costæ, valleys and colles consequent on different stages of wear, increase in size from the first Premolar (Pm 2) up to m 2 where a maximum of development is reached. The entrance of the anterior valley (A) also descends from before backwards, viewed in relation to the size of the tooth until in m 3 it is situated but 0·1 to 0·2 inches from the base of the crown. Generally in the Premolars it is blocked up by a small cusp and often in the true molars. On the grinding surface of the crown, a process of enamel thrown inwards and slightly backwards from the exterior lamina † [L of fig 1—4] meeting a corresponding process thrown forwards and slightly outwards from the middle of the median collis intercepts the posterior portion of the anterior valley. The former (G) of these is the *Anterior*, the latter (H) the Posterior 'Combing Plate.' Sometimes they are fused together at their junction, completely insulating the portion (C) of the valley they cut off, sometimes they merely touch, or leave a small interstice communicating with the main portion of the anterior valley. In the bicorn rhinoceros of ‡ Sumatra the anterior combing plate is always absent, as also in those teeth which Cuvier and Professor Owen figure as *R.*

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* In a skull of R. Sumatranus (2936 of the Hunterian Catalogue) m 1 is beginning to be worn, while the whole of the milk molars are still in place. It belonged to an animal considerably older than the Thame, or Lawford Rhinoceros.

† 'Collis externus,' Brandt. 'Colline Premiere qui suit exactement le bord,' Cuv.

‡ Vide 2935. Mus. Coll. Surg.

leptorhinus, and in the three upper molars of *R. hemitœchus* (Falc.) from Kirkdale, in the Oxford Museum. In an example on the other hand of *R. bicornis*‡ it is rudimentary in the true molars, and well developed in the Premolar series. Thus with reference to the 'combing plates,' the latter species stands half-way between *R. tichorhinus* and *R. sumatranus*.

The entrance of the anterior is at a lower level than that of the posterior valley, and the former penetrates more deeply than the latter into the substance of the tooth. The anterior A and median B colles advance *obliquely* forwards and outwards instead of *at right angles* to the median line. The posterior collis generally bears a cusp on its summit. The anterior (M) area is much smaller than the posterior (N), with the exception of m 3. An oblique ridge running upwards and outwards from the inner side of the base traverses the anterior surface diagonally, forming an oblique guard. This, however, is not so well developed, as in the *R. leptorhinus* of Cuvier and Professor Owen, or in the bicorn African or Sumatran species.

The median groove cuts the base in the true, never in the premolars; of the 4 fangs the inner pair are connate, *in the premolar* series ungrooved on the inner side, *in the true molars* always grooved widely and deeply.

Among the aberrant teeth one, m 2, is remarkable for having the entrance of the anterior valley completely blocked up to the summit of the crown, which is but little worn; one, m 1, also possesses two cusps, the one below the other, at the entrance of the anterior valley, the whole crown being at the same time considerably incurved. A cingulum, or 'bourrelet,' is present on the exterior of one last molar.

1. Pm 2. Of Pm 2 I have not met with any example. It is however figured and described by Brandt.* It is characterized by its small size, and the stout ridge on its anterior aspect.

2. Pm 3. The inner base of Pm 3 regularly rounded, is unmarked by a vertical furrow. The second costa (K 2) is higher, broader and more prominent than the anterior, from which it is divided by a deep groove. The median groove (I) does not traverse the base of the exterior surface.

Measurements.

	(1)	(2)	(3)	(4)	
Maximum	1·16	1·5	1·5	. . .	Wookey Hole.
Average	1·04	1·44	1·47	4·61	
Minimum	1·1	1·38	1·38	. . .	Wookey Hole.

3. Pm 4. In the unworn or slightly worn crowns of Premolar 4, the exterior bears 5 costæ, the second higher than the first, from which it is divided by a deep groove, the third narrow, sharply defined, and higher than the second apically, gradually dying down

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* Vide 2941. Mus. Coll. Surg.

† Op. cit. p. 303.

and coalescing with the fourth at the distance of 1·1 to 1·4 in. from the base. The 5th or posterior costa, separated from the fourth by an elongated V-shaped groove disappears at a distance of from 0·9 to 1·2 in. from the base of the crown.

The anterior is much larger than the middle collis. Of the two valleys the anterior has its entrance from 0·7 to 1·1 from base, the posterior, widest posteriorly and roughly triangular in the unworn crowns from 0·6 to 0·8 inches.

Measurements :

	(1)	(2)	(3)	(4)	
Maximum	1·5	1·9	1·8	6·5	Wirksworth.
Average	1·32	1·8	1·69	5·66	
Minimum	1·25	1·6	1·55	5·2	Wookey Hole.

4. M 1. Of the 4 costæ on the exterior of M 1, in the unworn or slightly worn tooth the anterior is the most prominent, in those that are less worn, the anterior and the third. A groove deeper than the median divides the anterior from the second, while a broad shallow depression divides the 4th, or posterior costa, from the third. The upper portion of the latter is slightly flattened. The bases of the median and anterior colles are equal or subequal in inward extension, and consequently there is less difference between the antero- and postero- transverse measurements than in m 2. The entrance of the anterior valley is situated from 0·4 to 0·8 inches from the base of the crown. In one molar abnormal, in other respects it is 0·93.

Measurements :

	(1)	(2)	(3)	(4)	
Maximum + cement	1·6	2·33	2·0	7.2	Wirksworth.
Average	1·54	2·08	1·9	6·49	
Minimum	1·36	1·95	1·85	6·0	Wookey Hole.

5. M 2. Of the 4 costæ on the exterior of m 2 the third is the highest, the second, abruptly mapped off from the first by a deep furrow, dies down into the median groove, while the 4th is divided from the third by a broad shallow depression, dying away below. The anterior collis is by far larger than the median, and its base has a far greater inward extension than that of the latter. In both these respects it contrasts with m 1. The height of the entrance of the anterior valley from the base varies from 0·6 to 0·9, of the posterior from 0·7 to 1·1 inches.

Measurements :

	(1)	(2)	(3)	(4)	
Maximum	1·75	2·5	2·1	7·7	Wirksworth.
Average	1·77	2·36	1·98	7·07	
Minimum	1·7	2·0	1·9	6·7	Wookey Hole.

6. M 3. The last molar, the most inconstant in form of all the teeth, in section sometimes trapezoid, sometimes triangular, is very frequently confounded with the other molars. In No. 856, of the Hunterian Catalogue of Fossil Mammals, it passes for 'the antepenultimate, or fifth molar;' in Nos. 859 and 865 for 'the penultimate, or sixth molar of the upper jaw.'

The exterior surface is marked by three broad ill-defined costæ, and is supported by two roots, the posterior of which is connate with the posterior of the inner surface. The posterior surface forms instead of a right a very obtuse angle with the exterior, from which it is divided by the third costa supported by the posterior and outer fang. The median groove is broad, deep and vertical.

The anterior far exceeds the median collis in every dimension. The anterior valley, with entrance from 0·1 to 0·4 inches from base of crown, is deep, narrow and nearly parallel to the median line. Posteriorly the two 'combing plates' meet and insulate a portion of it, which Brandt considers the homologue of the posterior valley. But its external position, its opening into the anterior valley in the unworn tooth, and its being mapped off from it by the combing plates, show that it is the representative of the intercepted part of the anterior valley, that he terms Fossula externa. The median collis is very small and variable in form, sometimes being a rounded pillar, at others a plate with a trenchant free edge. In one specimen in my possession it is fully developed, and equal in size and inward extension to the anterior collis.

In the great majority of the specimens that I have examined, the posterior valley and collis are represented respectively by a faint groove on the posterior aspect and a small cusp* at its base. A series from Wookey Hole, shows the gradual increase of both in size, until the groove deepens into an undoubted valley, walled in posteriorly by a stout pillar 0·9 inches high, and in every respect the homologue of the posterior collis in the other molars. Deslongchamps† has arrived independently at the same conclusion with respect to the groove, which he terms, "Vallon posterieur mais rudimentaire."

Measurements:

	(1)	(2)	(3)	(4)
Maximum	1·85	2·2	1·6	7·0
Average	1·77	1·99	1·4	6·44
Minimum	1·64	1·88	1·4	6·4

§ 6. Permanent Lower Molar Series.—In the permanent lower molars the exterior aspect of the crown is divided by the median groove * (I) more or less deep and inclined forwards into two equal or subequal areæ, of which the anterior is the higher. The posterior (N) is more or less rounded off, without costæ. As in the upper molar series the premolars may be differentiated from the true molars by the median groove traversing the base in the latter, and never in the former. The inner aspect is divided by the two V-shaped open valleys, of which the anterior (A) is smaller and shallower than the posterior (B), into three colles. Of these the anterior (D) is the smaller, the median (E) the larger. In the premolar series the latter is generally more tumid than the rest. The two 'lobes' of the tooth, are composed, the anterior of the median and anterior colles, the posterior, of the posterior collis (F). The summit of the unworn anterior lobe is broadly and deeply, that of the posterior more faintly notched. The anterior aspect is flattened except in Pm 2, and traversed by a small ridge or guard, springing from the first costa and reaching inwards. It is found generally at a distance of two-thirds of the whole length of crown from the base, and is very strongly developed in the true molars. The posterior aspect rounded except in M 3, is also traversed by a small upward tending guard, generally arched, but sometimes straight. Springing from the outer side it dies away without impinging upon the inner surface of the third collis.

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* In a specimen in the British Museum from Harrowdean this is absent.

† 'Memoire sur nombreux Ossements de Mammifères Fossiles trouves aux environs de Caen,' p. 57, pl. viii. fig. 4.

The fangs are four, divaricate connate, the outer with its fellow of the inner side. The tips of those of m 1 and 2 are slightly twisted, the anterior pair dextrally, the posterior sinistrally. Among the anomalies is the presence of a cusp at the entrance of the Posterior valley in M 1, 2, 3, at the posterior side of the same valley in M 1, and at the anterior side in Pm 3. The 'Crochet' on the anterior border of the Posterior valley which M. Christol† mentions may be cited also as an accidental variety. A cingulum also is found on the inner and outer surfaces of M 1 and 2.

1. Pm 2. In Pm 2 (fig. 7), the first of the Premolar series, the median groove (I) is very shallow and oblique, and, if prolonged, would cut the middle of the exterior and posterior fang. The anterior (M) is twice as large as the triangular posterior area (N), and is traversed by a faint diagonal depression, which separates the two almost obsolete costæ. The exterior base is tumid. The anterior valley (A) is shallow, open, and V-shaped, the posterior (B), very narrow and deep, is constricted by the great posterior extension of the median collis, which here reaches its relative maximum of development. The anterior collis is small, and the ascending ridge which sweeps round the anterior valley presents a trenchant edge.

	Inch.
Maximum height of anterior area	1·3
,, ,, posterior area	1·06

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* Fig. 5, 6, show the plan upon which the permanent lower molars are formed.

† Ann. des Sciences, Vol. iv. 1835.

Measurements :

	(1)	(2)	(3)	(4)	
Maximum	0·85	0.75	0·65		Magdeburgh.
Average	0·78	0·65	0·66	2·6	
Minimum	0·75	0·6	0.63	2·5	Wookey Hole.

2. $\overline{\text{Pm 3}}$. The median groove of the $\overline{\text{Pm 3}}$ is far more vertical, and more strongly marked that in $\overline{\text{Pm 2}}$, and is terminated inferiorly at an average distance of 0·58 inches from the tumid base of crown. The two costæ on the anterior area are faintly defined. The valleys are deep, and well marked.

	Inch.
Maximum height of anterior area	1·7
„ „ posterior area	1·45

Measurements :

	(1)	(2)	(3)	(4)	
Maximum	1·06	0·9	0·9	3·8	Caswell Bay.
Average	0·96	0·83	0·86	3·46	
Minimum	0·88	0·76	0·85	3·4	Wookey Hole.

3. $\overline{\text{Pm 4}}$. In Premolar 4 the anterior area is flattened, and traversed by a diagonal groove, more or less deep, separating the first from the second costa, the latter of which, more prominent than the fomer, is isosceles-triangular, with a tumid base. The median groove, deeper than in $\overline{\text{Pm 3}}$, is terminated inferiorly, at an average distance of 0·45 inches from the base of crown.

	Inches.
Maximum height of anterior area	2·22
„ „ posterior area	1·85

Measurements :

	(1)	(2)	(3)	(4)	
Maximum	1·4	1·03	1·08	4·6	Ilford.
Average	1·23	1·03	1·0	4·1	
Minimum	1·15	1·15	1·08	4	Wookey Hole.

4. $\overline{\text{M 1}}$. In M 1, as in the two following molars, the posterior collis is, relatively to the other two, much larger than in the Premolar series, and the median groove traverses the base of the crown.

	Inches.
Maximum height of anterior area	2·2
" „ posterior area	1·9

Measurements :

	(1)	(2)	(3)	(4)	
Maximum	1·55	1·1	1·1	5·1	Ilford.
Average	1·39	1·17	1·12	4·64	
Minimum	1·25	1·15	1·15	4·5	

5. $\overline{\text{M2}}$. With the exception of the increased depth of the median groove and the larger size, I am unable to detect special characteristics in $\overline{\text{M 2}}$.

Measurements :

	(1)	(2)	(3)	(4)	
Maximum	1·75	1·15	1·17	5·3	Ilford.
Average	1·57	1·20	1·12	5·01	
Minimum	1·4	1·1	9·5	4·7	Wookey Hole.

6. $\overline{\text{M 3}}$. The median groove in the last molar reaches its maximum depth ; the posterior area is either rounded off to join the posterior wall of the posterior collis, or, more usually, is slightly flattened, especially in the unworn tooth. The posterior collis is wider at the base than in the other molars, and of greater posterior extension. It is equal, or sub-equal to the median.

Measurements :

	(1)	(2)	(3)	(4)	
Maximum	2·1	1·2	1·1	5·45	Wirksworth.
Average	1·69	1·16	1·09	5·27	
Minimum	1·48	1·2	1·0	4·85	Wookey Hole.

§ 7. THE UPPER MILK MOLARS.—The Upper Milk Molars* of *R. tichorhinus*, four in number, and, with the exception of Dm 1, in plan resembling the true molars [§ 5. § 6-4, 5, 6.] differ from them in their far smaller size, in their valleys being relatively much larger, their colles much smaller, and in the second costa always being the higher. The median groove traverses the base of all.

1. $\underline{\text{Dm 1}}$. The first Milk Molar† [fig. 1.], of which I have seen only one example, presents four well marked costæ (K) on its external surface, the first divided from the second by a broad V-shaped depression, that from the third by the broad median groove (I), while a narrower and more shallow groove divides the third from the fourth.

The anterior valley (A) is divided into three portions by the fused combing plates [G, H]. The first of these is a deep open cavity, the second the space intercepted by the combing plates, and lastly, at a higher level the inner and smaller cavity.

The anterior collis (D) is split up as it were into two cusp-like portions of which the posterior is the higher, by the fused combing plates that enter into the internal surface of the tooth. The median collis (E) is very large, and the posterior valley (B) is far larger than the anterior (A). The anterior portion of the crown presents an ascending trenchant edge. The posterior surface is rounded and flattened. Of the four fangs the anterior and posterior pair are respectively fused together, as in the lower molars.

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* The verticality of the colles, and the non-development of the anterior combing plate in fig. 125 of The British Fossil Mammals, prove that the tooth figured is not that of R. Tichorhinus. It probably belongs to *R. hemitoechus* (Falc.)

† Dr. Schmerling, Recherches sur les Ossemens Fossiles découvertes dans les caverne de la Province de Liège, Vol. ii. pl. xxiii. fig. 3, gives a figure.

Measurement :

	(1)	(2)	(3)	(4)
Wookey Hole	0·8	0·5	0·8	2·7

2. Dm 2. [fig. 2] The second Milk Molar bears four and sometimes 5 costæ (K). The groove between the first and second is by far the deeper. The anterior collis (D), small and slightly curved, is sometimes divided from the exterior lamina (L) by a depression. Anterior to the point of juncture is a broad trenchant plate in the unworn and partially worn tooth overlapping the posterior and outer edge of Dm 1. The median collis (E) is divided from the posterior (F) by a depression in the unworn tooth. The entrance of the anterior valley is wide, and partially blocked up by a cusp ; and in all that I have examined there are small vertical folds on the posterior wall. The combing plates are fused together insulating the accessory valley (C), the walls of which are sometimes minutely folded.

Measurements : *

	(1)	(2)	(3)	(4)
Wookey Hole	1·2	1·2	1·1	3·9
„	1·2	1·2	1·15	4·0

3. Dm 3.† (fig. 3) Of the four costæ of the third Milk Molar the second (K 2), round and tapering, is mapped off from the first by a deep V-shaped groove. It extends to the summit of the anterior as the faint and low third does to that of the posterior area. The median groove (I), inclined a little forwards, is well marked, and posterior to it is a faint elevation in the upper half of the tooth. The posterior wall of the anterior valley (A) is folded; its entrance is wide and sometimes blocked up by a cusp. The accessory valley (C) is completely insulated by the fused combing plates. The guard strong, but irregular at the inner side of the anterior aspect, and broken into cusps, is continued on the plate that overlaps the preceding tooth, as in Dm 2.

Measurements :

	(1)	(2)	(3)	(4)	
Maximum	1·4	1·5	1·4	5·0	Wookey Hole.
Average	1·3	1·48	1·38	4·8	
Minimum	1·32	1·42	1·26	4·7	Wookey Hole.

4. Dm 4. (fig. 4) Of the four costæ (K) of the last Milk Molar,‡

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* I am unable to give average measurements, as, with the two above exceptions, all I have examined are germs with the base of crown more or less broken.

† Comp. fig. 7, pl. xxiii. of Dr. Schmerling. Op. cit.

‡ Comp. pl. xxiii. fig. 10, of Dr. Schmerling. Op. cit.

the second is strongly marked, the third broad and ill-defined, and traversed in its upper half by a faint depression. The groove posterior to it is broad and shallow. The anterior valley (A) advances with scarcely any curvature straight to the anterior and outer angle of tooth. The combing (G H) plates are fused together except in one instance. The anterior collis (D) is much larger than the middle (E), and is deeply marked by the inner termination of the guard.

Measurements :

Maximum	1·6	1·8	1·75	6·0	Kents Hole.
Average	1.51	1.62	1·57	5·8	
Minimum	1·4	...	1·58	...	Wookey Hole.

§ 8. LOWER MILK MOLARS.—The two lower jaws from Thame and Lawford, in the Bucklandian Museum, already alluded to [§ 4,] and described by Professor Owen,* as containing the Premolar dentition, differ from the rami of the adult in the following points. The first tooth is situated far nearer the symphysis, all the teeth are much smaller in vertical height, the fangs are much less solid and more divaricant, with the exception of Dm 1, than in the permanent series. They in common with others that I have examined, by all these characteristics are shown to be young jaws containing the milk dentition, a portion of which (—Dm 3, and 4,) —I found *in situ* above Pm 3, 4, in the jaw of an adolescent animal from Wookey Hole. The arguments† therefore based upon the hypothesis that these jaws contain the permanent dentition, and especially Pm 1, fall to the ground. The teeth in outline only, and general arrangement of valleys and colles [§ 6] resemble the permanent series. A glance, however, at the measurements of each, shows the vast difference between them.

The fangs are 4, those of Dm 1 excepted, divaricant, excavated underneath, and connate as in the permanent lower molars.

1. Dm 1. Fig. 5, 6, *a* and the median groove (I) faintly impressed on Dm 1 and extending from the apex of the crown to the posterior angle of the base cuts off an anterior area (M) twice as great as the posterior. The former of these is also divided by a faint diagonal depression into two costæ, (K) of which the second is tumid, and more prominent than the first. Of the two valleys, the anterior (A) is but faintly impressed, the posterior (B) is deep, and constricted apically by the large posterior extension of the median collis (E) as in Pm 2. The anterior portion of the crown presents a trenchant ascending slightly curved edge, the anterior collis (D) being very small and insignificant. The two connate fangs are either implanted in one alveolus, or in two with but a thin partition between them. Of unusual length and far more

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* Brit. Foss. Mam. pp. 337—342. Figs. 128, 137.

† Op. cit. pp. 363, 364.

stout than the rest of the fangs, the consequent depth and size of the alveolus has given rise to the supposition, that it must have belonged to a premolar one. In one specimen, in my possession, it is visible even after the appearance of Pm 2 above the jaw.

A beautiful figure of this tooth is given in the British Foss. Mam. fig. 137, together with a description, page 339. The vertical height of an unworn crown from Wookey Hole is 0·6 inches.

Measurements :

	(1)	(2)	(3)	(4)
Wookey Hole	0·6	0·4	0.46	2·0
Wookey Hole	0·5	0·38	0·45	
Lawford	0·58	0·36	0·545	

2. Dm 2. (Fig. 5, 6, β) In Dm 2, the median groove is strongly impressed, the depression dividing the first from the second costa is shallow and wide. The second costa (K 2) is by far the most prominent. The anterior valley (A) is well marked, open, and subdivided into three portions by two small processes of enamel, of which the middle is the larger. The deep posterior valley (B) is constricted by the posterior extension of the median collis (E). This bears a faint cusp posteriorly about $\frac{2}{3}$ of the length of tooth from the base of crown.

Measurements :

	(1)	(2)	(3)	(4)
Lawford	0·85	0·5	0·6	
Wookey Hole	0·95	0·53	0·65	2·8
Wookey Hole	0·85	0·53	0·6	

3. Dm 3·4. The following characteristics, which obtain in a large number of teeth, show that they are either the third or the fourth milk molars. I can detect no difference between them. The median groove (I) is well developed, and insulates the anterior from the posterior lobe, as in the true molars. The anterior area (M), the higher of the two, is flattened, and divided into two costæ by a vertical depression, more or less deep. The anterior valley (A) is at a higher level, and smaller than the posterior. The anterior collis (D) is larger than the posterior, and is flattened.

The tooth γ in Figs. 5 and 6 is the third of the milk series.

Measurements :

Dm 3	(1)	(2)	3)
Jaw, Wookey Hole	1·35	0·75	0·76
,, Lawford	1·33	0·73	0·75
,, Thame	1·3	0·83	0·83
Dm 4			
Jaw, Lawford	1·3	0·8	0·88
,, Thame	1·36	0·93	9·25

EXPLANATION OF FIGURES.

A, Anterior. B, Posterior. C, Accessory Valleys.
D, E, F. Anterior, Median, Posterior Colles.
G, Anterior, H, Posterior "combing plates."
I, Median Groove.
K, Costæ.
L, Exterior Lamina.
M, Anterior, N, Posterior Area.

Fig. 1. Dm 1. Upper Jaw, Wookey Hole.
2. 2. " "
3. 3. " "
4. 4. " "
5. Lower Jaw, containing Dm 1, 2, 3, from Wookey Hole. Exterior View.
6. " " " " " Interior View.
7. Premolar 2 of the Lower Jaw, right side.

LVII.—On Animal Dextrine, or Amyloid Substance, its History and Physiological Properties. By Robert MacDonnell, M.D.

It is now some years since materials resembling in some respects starch or dextrine of vegetable origin, have been recognized in the animal organism. The term Amyloid substance, so simply indicating this resemblance to starch, has been applied to these materials; and we now know that under this common name are embraced at least two compounds, which appear to be essentially distinct from each other. These I have elsewhere proposed to indicate as the Amyloid substance of Bernard, (or of the first species); and the Amyloid substance of Virchow, (or of the second species). The former is that of which I treat in the following pages; the latter, discovered by Virchow, in 1854, and now familiarly known to pathologists, although possessing many of the structural, chemical and optical properties of starch as it occurs in plants, cannot in the present state of our knowledge be considered as the animal dextrine.

The discovery of the Amyloid substance of Bernard was announced by the distinguished Professor, whose name it bears, at the meeting of the Academie des Sciences, held on March 23rd, 1857. Professor Bernard, in obedience to his theoretic views as to its use, named it "Glycogenic Substance." Hensen, somewhat prior to Bernard, and quite independently of him, had isolated this substance, the discovery of which, without doubt, constitutes one of the most important facts of animal physiology. Since its discovery its physiological properties and relations to various organs and tissues have been carefully investigated by various physiologists, and by none more successfully than by M. Charles Rouget.

In the following pages it is not intended to advance any theoretic views as to its function or ultimate destination in the animal economy, but simply to bring before the reader a resumé of what is known as to its physiological properties and relations.

The Amyloid substance of Bernard, or of the first species, is a ternary compound, isomeric with dried grape sugar. It is a neutral, whitish, inodorous, insipid matter, soluble in water, insoluble in alcohol and strong acetic acid. Its solution in water is milky and opalescent.

In the presence of saliva and other animal ferments, it is converted into sugar, which ferments on the addition of yeast, and reduces the cupro-potassic solution; iodine in contact with it produces a peculiar brown colour, more or less intense, disappearing on the application of heat, and reappearing when the solution cools below 80°; like vegetable dextrine it causes the plain of polarization to deviate to the right.

In order to determine its presence in any tissue perhaps the readiest method is to use the microscope. By adding some acidulated tincture of iodine the characteristic brown colour is at once produced. This may be dispelled by gently heating the slide, and returns when it has cooled. Many of the tissues, however, in which it exists, contain it so abundantly that it can be obtained even from small portions in sufficient quantity for chemical examination.

It may be obtained, according to circumstances, by any of the following processes:—1st. *Alcoholic process.* Cut the organ or tissue (say the liver of a recently killed rabbit, lately fed on carrots and in full digestion) into thin slices and throw them into rather more than their own bulk of boiling distilled water, boil for a few minutes, then bruise the whole to pulp in a mortar; boil once more for a few minutes, throw the whole in a filter, and allow the milky solution, which passes through, to fall into four or five times its volume of alcohol. The amyloid substance falls as an abundant, white, flaky precipitate; any albuminoid matters present are of course precipitated along with it, and must be got rid of by washing the precipitate with a strong solution of caustic potash.

This process is best adapted for tissues in which albuminoid matter is not abundant, as the liver, and if instead of using alcohol, methylated spirit be substituted, the amyloid substance may be got in a state of tolerable purity at a moderate cost, and at least sufficiently pure for many experimental purposes. In this way also the amount existing in any liver may be very accurately determined, even without the use of the solution of caustic potash, as the quantity of gelatine extracted from the liver by so short a time of boiling is very small indeed, and does not interfere with general results.

2nd. *Acetic acid process.* The organ, or tissue, to be examined is boiled is a small quantity of distilled water; the whole is then bruised in a mortar with animal charcoal thrown in a filter, and the droppings allowed to fall into glacial acetic acid. The amyloid substance falls as a more or less abundant flaky precipitate. Gelatine and casoin are not completely arrested in the filter by animal charcoal, but the first is soluble in acetic acid, and the second, although at first precipitated, is at once redissolved by the glacial acid. This process is an excellent mode of determining whether the amyloid substance of Bernard is present in any tissue, but it is not an economical mode of preparing it in large quantities, and moreover it is necessary to wash the precipitate repeatedly with alcohol to get the material free from acetic acid, which cannot be altogether got rid of by evaporation.

3rd process, by means of an alcoholic solution of potash. This mode answers remarkably well for dealing with small portions of the tissues of young or foetal animals. A strong, nearly saturated solution of caustic potash in alcohol is to be prepared, it must be used soon after being made, as it is likely by keeping to become brown of the colour of sherry; a portion of the tissue to be examined is placed in a test tube, and some of the alcoholic solution of potash poured in it; it is then let stand for twenty-four hours, when upon shaking it, it dissolves away the azotised matters, leaving a white precipitate of the amyloid substance. This is to be acted upon again by further addition of the same solution, and afterwards washed free of potash with alcohol.

This process is not satisfactory in its application to the tissues of the adult animals, for the albuminoid materials are dissolved with greater difficulty, and in dissolving, become of so dark a colour that it is difficult to obtain a pure specimen even when the tissue is rich in animal dextrine.

Not long since the amyloid substance of Bernard was regarded as a product formed exclusively by the liver; we now know, however, that it is by no means limited to one organ or one tissue, and that although the liver is the chief focus of its formation during adult life, during foetal existence it is met with much more widely distributed.

On the Formation by the Liver of the Amyloid Substance of Bernard.

Has the liver the power of forming amyloid matter of the first species from azotised materials? This question may be answered in the affirmative. The connexion between this substance and sugar is so close that the question may be made more general. Are saccharine and amylaceous matters formed in the animal economy from azotised materials? Chemists have obtained of late years a considerable number of results which tend to show that ternary compounds may result from azotised elements. Lehman obtained sugar from hacmatine. Dogs fed for many days exclusively on flesh meat are found to have animal dextrine in the liver, and on being killed sugar is found in the blood and tissue of that organ. Bitches fed exclusively on flesh meat for many days continue to form milk containing sugar. I have verified the same fact in cats. It has been argued, however, that nevertheless the saccharine and amylaceous matters are not formed within the system, but enter from without; that herbivorous animals find in vegetables the amylaceous principle; that it accumulates in their tissues and thus gets entrance to the organisms of the carnivora which devour their flesh.

That this is not the case I have already shown by a careful examination of the flesh meat of our markets. It is certain that the mutton, beef, veal, rabbit flesh, &c. of our markets contain ordinarily not a vestige of amyloid substance. When, however, adult animals are fed on food containing much starch or sugar the muscular tissue becomes impregnated with dextrine having all the characters of the amyloid substance of Bernard. A pigeon was fed for six days on starch and sugar; the liver yielded 25·5 grains of amyloid substance, and 5 grains of an identical material were obtained from the muscles of the breast. Lawson has demonstrated its presence in the flesh of horses; it exists also in the flesh of hybernating animals, but not abundantly, and whether in this case it is merely an impregnation of the muscles with a material formed in excess by the liver, or whether it is an arrest of the normal nutritive process of muscle resulting from inactivity it is not possible to determine with exactness.

Dr. Davy has shown how great is the effect of diet containing much starch and sugar in the amount of amyloid substance formed by the liver. Indeed it is surprising, and almost incredible, to what a degree and with what rapidity the liver may be increased and diminished in bulk by the administration of particular kinds of diet. How far this is due to the quantity of animal dextrine stored up in the liver the following table will show.

TABLE showing the quantity of amyloid substance found in the entire liver of animals fed for some days on the following materials.

	On a diet consisting almost exclusively of sugar & starch.	On a diet of fat.	On a diet of glutin bread.	On a diet of gelatine.
Dogs . .	980 grs.	Hardly any	125 grs.	None
Rats . .	7 ,,	None	3 ,,	,,
Pigeons .	25½ ,,	,,	1 ,,	,,
Rabbits .	45 ,,	,,	8½ ,,	,,

It would appear, therefore, that Prof. Bernard is in error in asserting that the animal organism can prepare amyloid substance from gelatine.* According to my observations the livers of dogs and rats fed on gelatine give the same results as the livers of those animals when no food at all is given to them: and the same is true when they are fed on fat.

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* L'Union Medicale, No. 35, p. 554, 1859.

The amyloid substance found in the tissue of the liver is met with in greatest abundance about six hours after a full meal, and from this time, if the animals are not fed, it diminishes gradually, and after some days of abstinence has wholly disappeared. This disappearance of it during abstinence is not retarded by keeping the animals at an elevated temperature, nor accelerated by the reverse.

It is a fact worthy of observation, that the liver in carnivorous animals is much larger than in vegetable feeders, and also that the larger the liver is the less is the per centage of the amyloid substance contained in it, the animals of course being fed on their ordinary food, in health, and killed during digestion. Thus in cats the liver on an average weighs the $\frac{1}{19}$th part of the weight of the animal's body, while in rabbits that organ does not generally exceed from the $\frac{1}{30}$th to the $\frac{1}{35}$th part of the weight of the animal, while the cat's liver yields on an average 1·5 grains per cent. of amyloid substance, and the comparatively small rabbit's liver 3·7 per cent.

From a considerable number of observations it may be stated in general terms that the livers of healthy cats fed exclusively on meat are nearly double the weight of the livers of rabbits, the animals being of the same size and killed at the time of full digestion. But the livers of the meat-eaters are not nearly so rich in amyloid substance, so that even allowing for the much greater bulk, the liver of a large well fed cat will not yield more than two-thirds as much of this material as the liver of a healthy rabbit fed on carrots, bread, and parsley.

It is not necessary that saccharine or amylaceous substances should be present in the food to ensure the formation of amyloid substance by the liver: strictly carnivorous animals seem to form it even more readily from meat than from vegetable food if the latter can be introduced. Cats are sometimes found to be very fond of asparagus, yet if fed on this vegetable the liver gets small and forms but little amyloid substance. Two young cats of the same age, size, colour, and sex, were fed, one on meat, the other on asparagus, for eight days; they were then killed, the liver of that fed on meat weighed 1230 grs. and yielded 17 grains of amyloid substance; while the liver of the other weighed but 630 grs. and gave but 3 grs. of amyloid substance. In short, in the coure of a few days the liver of one was found to weigh little more than half as much as that of the cat fed on the diet which it is natural to presume was best fitted for its nourishment, although less rich in saccharine materials. On the other hand, in rabbits fed for some days on boiled eggs, meat and butter, the amyloid substance had diminished in quantity as much as if they had not been fed at all.

Of the Formation of the Amyloid Substance of Bernard in the Placenta and other Structures.

Next to the liver the placenta was the first organ in which animal dextrine was found to exist. Bernard discovered it in the placents of rabbits, guinea pigs, etc., the epithelial cells of which are filled with it at an early period of their development. As met with in the placenta it has the same characters identical as when found in the liver. Its presence in the placenta-cells may be readily demonstrated under the microscope by the aid of the acidulated tincture of iodine; it may however be obtained from the placenta by any of the methods already mentioned in sufficient quantity to be submitted to chemical examination, converted into sugar, fermented, &c. The cells containing it appear to be situated principally between the maternal and foetal portions of the placenta. The multiple placentulae (cotyledons) of the ruminants do not contain any amyloid substance, but Bernard observed that in this class of animals this substance is found in certain cells of the amnion, which in some ruminants are collected in masses on the foetal surface of this membrane. These little masses, which true to his glycogenic theory he names "les plaques hepatiques de l'amnios," in the cow are studded in great numbers over the inner surface of the amniotic membrane: to the naked eye they look like drops of bees' wax of various sizes, from that of a millet seed to that of a split pea, or larger, sticking over the amnion but not evenly distributed over it. These amyloid patches of the amnion have not the appearance of being glandular bodies, but consist of large epithelial scales filled with amyloid substance. In the sheep, patches of the same kind as in the cow do not exist. In this animal the amyloid substance exists in the epithelial cells which line the sac of the amnion and in the papillae found in this membrane where it covers the funis and elsewhere. It is apparently about equally abundant in the placenta of cats and rabbits, and in such it is found in larger quantity at a time when the growth of the foetus is progressing rapidly. The placenta taken from a single female rabbit four weeks pregnant gave five grains, those from a female cat five weeks pregnant, six grains. Shortly before the birth of the young it has almost, if not totally, disappeared from the placenta.

The presence, however, in the amnion or placenta of epithelial scales, containing amyloid substance, is a fact of quite secondary importance to the general fact that this substance enters largely into the constitution of most of the tissues of the embryo. Its existence does not indicate a new function of an organ or tissue doing temporarily the duty of the liver, but it indicates a new fact with regard to the development of certain structures:—a new property of tissue.

By observing that lactic acid was abundantly developed in the muscles of the foetus, Prof. Claude Bernard was led to discover sugar in this tissue, and subsequently amyloid substance. In his

Lectures on Experimental Physiology (1854-5, p. 250) he has drawn attention to the existence of a sort of animal fecula in the muscles and lung of the foetus: but at this time he did not isolate it so as to investigate its properties. At a later period he communicated an elaborate memoir on the subject "of the glycogenic matter (amyloid substance), considered as a condition of development of certain tissues of the foetus before the appearance of the glycogenic function of the liver," to the Academy of Sciences. This memoir was read on the 4th of April, 1859. In a note likewise, appended to the termination of his memoir, "upon a new function of the placenta," in the 2nd volume of the "Journal de la Physiologie, &c." page 39, he speaks on the same subject. "In the foetus," he says, "there exists glyco-
" genic cells in the various epitheliums of the digestive and respiratory
" passages as well as in the skin and its appendages. The presence
" of glycogenic cellules may be very well observed, for example, in
" the soft horny structure of the hoof of the foetus of the cow, and
" this matter may be seen to disappear in the parts which are the
" seat of more advanced organisation. These obervations would lead
" one to think that in these instances the glycogenic matter is not
" changed into sugar, but that it seems to enter directly into the
" constitution of the tissues becoming organized along with it; and
" one may, I think, extend this idea and apply it to the development
" of the other tissues of the foetus which contain glycogenic cells,
" as well as to the phenomena of nutrition in the adult with reference
" to the part played by the glycogenic matter of the liver, &c. &c."

It must be remembered, however, by those who are anxious to establish with precision and truthfulness the history of this question, that the first researches of M. Charles Rouget, as to the existence of *Zoamyline* in the epithelial cells of the skin and mucous membrane were made prior to the note just quoted, and that the facts and ideas which this able physiologist has since developed in his articles "on the amyloid substances in the tissues of animals," in the second volume of the Journal de la Physiologique were set forth at several meetings of the Societé de Biologie, especially its meeting on the 5th of March, 1859.

Although Prof. Claude Bernard has by his discovery of the amyloid substance of the liver, and by the addition of many interesting and important facts to our knowledge of this substance, done much for science, yet it would appear that M. Charles Rouget was in truth the first to give to these facts their true signification. It was he who announced that the presence of amyloid substance as a constituent part of the elements of normal tissues was not limited to a single order of animals, or to a single organ (the liver), but that these starch-like materials are common to the elements of many organs, sometimes only during certain periods of their development, sometimes during life, and that they play an important part in the definite constitution of the tissues of a great number of the invertebrata. He showed that in the larva of the batrachians, *zoamyline*, as he named it, does not show itself in any tissue (except perhaps in the muscles which move the branchial arches) up to the moment of the appearance of the posterior limbs. It then makes its appearance in the cartilage of ossification of these limbs. In the embryo of the chick the cartilaginous tissue is also the first in which it shows itself, and up to the fourteenth day of incubation it is not to be met with in any other tissue, except the horny membrane of the bill. In an embryo of a sheep of about two months, the cells of the cartilage of ossification, and those of the trachea showed in contact with iodine a colour absolutely like that of the horn cells. The muscular elements of animal life contain also at this epoch a considerable quantity of the amylaceous plasma. These elements have at this period the form of tubes, and are composed of a membranous wall, of a cortical covering and of a central canal. The surcolimma is not sensibly coloured; the cortical covering, formed by the peculiar granulations of the muscular substance, is only coloured yellow, like all the azotised matters. Within the central canal neither the nuclei nor the granulations (generally of a fatty nature) take any peculiar colour; the violet tint is exclusively confined to the liquid, homogenous, amylaceous plasma, which fills the central canal.

It is, I believe, to the condition and properties of the amyloid substance as met with in young and rapidly growing tissues, that we must chiefly look for a full explanation of the true function performed in the animal economy by this widely diffused ingredient of the organism. There is still an extensive field here open to physiologists, and one which will doubtless amply repay labour expended upon it. In concluding this resumé I may briefly enumerate the principal facts at present known concerning the existence of the amyloid substance in the foetal tissues. Any person who takes the trouble to examine the tissues of a mammalian foetus will be at first surprised with the large amount of starch-like matter with which they are impregnated. Nor is this confined to mammalia; indeed it would appear that there is a particular moment in their growth when this amyloid substance seems to be a formative matter from which many tissues are evolved; that in fact it is related to their growth and development as starch is to the growth and development of vegetable tissues. Let a small portion of the skin of a chick in ovo, at the moment when the epithelial cells have arranged themselves in the little masses which indicate the commencing development of the feathers, be placed under the microscope, and let some acidulated tincture of iodine be added, the peculiar brown colour will at once show every cell to be filled with amylacious matter, making a striking object. In the same way it may be demonstrated in the skin of the embryos of rabbits, cats, guinea pigs, sheep, oxen, pigs, &c. as also most abundant at the points where the aggregation of epithelial cells shows that the hairs are about to spring. Even more beautifully it may be seen in the denser horny structures; in the bill of the chick, the claws of the kitten, or the hoof of the foetal calf; and from the latter it can, by the alcoholic solution of potash, be obtained in sufficiently large quantity for chemical examination, fermentation, &c. Before the birth of the animal, as these tissues become fully developed, it vanishes from, or rather becomes in an altered form a constituent part of each. In the completely formed hair, feathers, horn of the foetus, it is no longer to be found.

The muscular tissues of the foetus are full of it; from twenty to fifty per cent of amyloid substance can be extracted from the muscles of foetal calves, of from three to seven months, by the aid of the alcoholic solution of potash. If a portion of the muscular tissue of a foetal calf, of about three or four months, be perfectly desiccated on a water bath and the residue reduced to fine powder, the albuminoid part may be washed out by treating it repeatedly with freshly made alcoholic solution of potash: one may thus obtain tolerably pure animal dextrine, equal in amount to nearly one half of the dry residue of the muscle so treated. The amyloid substance obtained in this way does not very readily become transformed into sugar on the addition of saliva; whether this may be caused by something peculiar in its constitution, or by the difficulty of getting, even after repeated washings, completely free of the potash, I have not yet been able satisfactorily to determine. It is very difficult, if not impossible, by any process to obtain it from the muscular tissue of the foetus without more or less admixture of azotised matters. It is found abundantly in the lungs of foetal animals, but not in bone or nervous tissue; neither does it exist in glandular structures save in their epithelial cells. Not even in the liver itself is it found during the early months of intra-uterine life. At the time of birth it has disappeared in some, and I believe I may say notably diminished in all the tissues in which it exists during uterine life. But to what extent and at what rate it disappears shortly before birth are matters for further investigation, and of investigation requiring time; inasmuch as there is some difficulty in procuring foetuses in sufficient numbers and sufficiently fresh, as the substance to be estimated is prone to decomposition from keeping.

LVIII.—WILD AND TAME CATTLE OF CAMBODIA.

'AMONG the *Ruminantia*, Cambodia has six species of Deer, three of wild cattle, and the Buffalo. Perhaps the most interesting novelty in East Indian Zoology to be found in Cambodia is the three species of *Bovidæ*. They are named by the people, *ngua kating*, *ngua deng*, and *ngua dam*. The first species is a rare animal of colossal size, with enormous horns. Its colour is black, and its motion is described as a continuous jump. From its great strength, it is much feared by the two other species, and even, it is said, by the Rhinoceros,* which cannot withstand its force and agility. The second named species, *ngua deng*, or red ox, is also of great size. The bulls have large horns, stretching forward; the cows are similar to the common domestic animal of the same species [?], but have not the hump. Both male and female are of a uniform brownish-red colour, with the belly and throat white. The third species, *ngua dam*, or black ox, is like the preceding in size; their colour is a black, or blackish grey. The cows, unlike the red cattle, have short horns, curved forward, and have not the pendent pouch of skin which the cows of the preceding species have under the throat. They frequently occur on the plains, in herds of from 50 to 300 at a time, and afford good employment to the huntsman. In the domestic state, two species of oxen are to be met with; they are universally employed as beasts of burden. The one is the common humped species, and the other one is a small race, of a red colour, without humps; both kinds have very short horns. The first occurs black, white, and red. The Buffalo, also extremely common in the domestic state, is more generally wild, the abundant pastures affording such great facilities for their increase. Those wild are of a much greater size than those domesticated, and have horns of enormous size. They are also endowed with an extraordinary amount of strength, and it is said, can knock over a good-sized Elephant. The horns and hides of this, as well as the oxen, form articles of commerce."—*Notes on the Antiquities, Natural History, &c. &c., of Cambodia.* * * * By James Campbell, Esq., Surgeon, R.N., F.R.G.S. Journal of the Royal Geographical Society, Vol. xxx. (1860), p. 197.

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* Probably the *Rhinoceros sondaicus*; but the two-horned *h. sumatranus* is likely also to be found in Cambodia, as elsewhere in the Indo-Chinese region. *Vide* Journal of the Asiatic Society of Bengal, vol. xxxi. (1862), p. 151.

Now what can all these *bovine* animals be?

1. The Buffalo is clearly distinguished, both wild and tame; the former being not improbably the descendants of domestic Buffaloes that have returned to wildness; for the Buffalo is not usually considered to be indigenously wild in the countries lying eastward of the Bay of Bengal. I remark, however, with surprise, the alleged difference of size between the wild and tame animals of this species, which is also the case in India, because in Burmah the tame Buffaloes approximate to the wild in magnitude and in development of horns. (*Vide* Journ. As. Soc. B. xxxi. p. 340.) The supposed reason for the comparatively stunted development of the domestic Buffaloes of India is, that the calves are deprived of an adequate supply of milk; but in Cambodia there would seem to be the same degeneracy in the domestic animal, although the Cambodians, as we may presume from analogy with the contiguous kindred nations, do not milk their cattle.

2. The *ngua kating*, from its "colossal size" and prowess, can hardly be other than the Gaour, or *Pyoung*, of the Burmese, *Bos gaurus;* but this animal has by no means "enormous horns" for its stature and bulk; and the very largest Burmese Gaours (or "Bison" of Anglo-Indians) have comparatively short and thick and stubby horns. (*Vide* Journ. As. Soc. B. xxxi. p. 336.) This animal not only inhabits all suitable parts of India, but also the Indo-Chinese

region and Malayan peninsula as far southward as Singapore; but its range does not extend to the great eastern islands.

3. The *ngua deng*, or "red ox," must surely be the *Tsoing* of the Burmese, or *B. sondaicus;* a fine young bull of which, received from Upper Pegu, is now living in the Zoological Society's Gardens, Regent's Park. This animal inhabits also the Malayan Peninsula, and the Islands of Borneo, Java, Bali, and Lombok; but has not been observed in Sumatra. In Bali it would appear to be extensively domesticated.

4. The *ngua dam*, or "black ox," occurring "on the plains, in herds of from 50 to 300 at a time," I can make nothing of. It certainly cannot be the Gayál (*B. frontalis*), or *mit'hun*, of the hill ranges bordering on the valley of Asam to the south; because the Gayál is emphatically a hill species, which soon pines and dies if removed to the hot plains, and moreover has the dewlap considerably more developed than in either of the two preceding species. The Gayál is not known to occur southward of Akyab, but abounds (in the domestic state) in the hills along the Kaladyne river (which flows from the north into Akyab harbour), and thence northward through Chittagong and Tippera, to the Khásya hills and ranges of mountains bordering the valley of Asam to the south, and along them eastward to the Mishmi hills at the head of that valley. The domestic herds are even found together with those of yaks: thus Lieut. K. Wilson, in his Memoir of a survey of Asam and the neighbouring countries (As. Res. xvii. p. 387), notices that "Mit'huns and chori-tailed cows were grazing in great numbers;" which implies that the Gayál can withstand a considerably low temperature for an animal of its particular subgroup, inasmuch as the yak is incapable of enduring even moderate heat. Whatever the *ngua dam*, or "black ox," of Cambodia may be, it most assuredly is not the *Bos frontalis*. Moreover, I know of no wild bovine species whatever that could be correctly described as having, in either sex, "short horns, curving forward."

5. The domestic humpless species, with short horns and of a red colour, is likewise enigmatical. It is perhaps identical with the Siamese humpless domestic race noticed by Mr. Crawfurd in his 'Mission to Siam and Cochin China,' p. 430, to which the attention of Sir R. H. Schomburgk (our respected Consul at Bangkok) has been directed; or it may prove to be a domesticated race of the *B. sondaicus*, like that of the island of Bali. But conjecture in such matters is of little avail.

As horns of all these beasts would appear to be articles of commerce, specimens of them might perhaps be sometimes obtainable, which would suffice to determine certain particular species as inhabitants of the country; but the difficulty of getting hold of specimens of such large animals, and of preparing and preserving even their skulls, can be appreciated only by those who have had some experience of travelling and collecting objects of natural history in so wild a region. EDW. BLYTH.

LVII.—REPORT ON THE DEPARTMENTS OF NATURAL HISTORY IN THE BRITISH MUSEUM FOR THE YEAR 1862.*

AT the period when the Natural History had assigned to it its share of exhibition space in the present building, a certain proportion of the specimens of each department had to be preserved in store.

The proportion of these specimens was greatest in the Department of Zoology; and the accumulation of unexhibited or store-specimens in the localities assigned for their reception had become so great, and the condition of those localities was such, as to call for a Report and representation as to the unsafe state of the specimens from the Keeper of the Zoology, dated 16th January, 1854. Additional space, if not for exhibition, yet suitable by dryness and ventilation for the better preservation of the store-specimens, was asked for.

From that date to the present, circumstances have prevented the acquisition of the desired additional space; nevertheless there has been an annual, and, in most years, augmenting addition of choice rarities to the vaults and recesses assigned for storage.

The arrangements made after the Report of 1854, for heating and ventilation, have, in a great degree, prevented the effects of damp; but the degree of heat for this purpose injuriously affects the specimens preserved in spirits of wine, by accelerating its decomposition and evaporation.

Each successive year of such storage increases the difficulty of keeping the specimens in a good state, and concentrates the time and labour of the staff on works of preservation, to the arrest of those of progress and improvement. The tickets, also, of the specimens rapidly perish or become effaced in the atmosphere of the vaults; they are as often renewed; but during the past year painted labels have been progressively substituted for the written records attached to the store specimens.

By these labours, uninterruptedly attended to, the stored and unexhibited specimens, many thousands in number, may be reported in the following condition:—

The unstuffed specimens of Mammalia are in a state fit for the purposes of scientific examination and comparison, and most of them in a state fit for future preparation and exhibition.

The Bird Skins in boxes are in good condition. Some of those kept in cupboards in the vaults begin to show the effects of damp; but not, as yet, to the detriment of their utility for purposes of comparison: they are not easily accessible for study.

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* Reprinted from a Return to an Order of the House of Commons for an Account "of the Income and Expenditure of the British Museum for the Financial Year ended the 31st day of March, 1863, &c."

The very large proportion of the class *Insecta*, preserved in drawers, and the dried specimens of *Arachnida* and *Crustacea*, similarly stored, are in a good state of preservation, and are more easily accessible for study or reference.

The collection of Osteology is in a state of preservation, but the conditions of its present storage in the basement vaults detract greatly from its scientific use, through difficulty of access to the specimens, and to the light requisite for examining them.

The specimens of the class *Mammalia*, *Reptilia*, and *Pisces*, preserved in spirits, and the specimens of invertebrate animals similarly preserved, have been kept by great expenditure of the antiseptic fluid in their present state of preservation.

The classes of *Tunicata*, *Acalepha*, *Annelida*, and *Entozoa;* the orders *Nudibranchiata*, *Inferobranchiata;* the families *Limacidæ*, *Oncidiadæ*, and *Firolidæ*, and most of the class *Cephalopoda*, are preserved in spirits, and stored in the vaults, where they crowd so closely the space allotted to them, that access to the specimens not in the front row is difficult and hazardous, and the utility of this part of the zoology is greatly abridged. These specimens of invertebrate classes and subordinate groups are in a state of preservation suitable for exhibition when the galleries may be acquired.

In the public galleries the proportion of the stuffed mammalia standing on the floor and attached to the wall shows only the degree of detriment which is inevitable from exposure with the utmost amount of care. The specimens of this class in the glazed wall cabinets are in a state of preservation; but, being divided amongst different rooms and compartments, the purpose of serial exhibition of the class cannot be fulfilled, and they are so crowded as to cause inconvenience and loss of time to the conservator, as well as to the scientific examiner of particular specimens.

The exhibited series of Birds is in a good state of preservation, and is arranged so as to give a serial illustration of the modifications of the class, and to afford facility of examination of individual specimens.

The exhibited series of Reptiles, Fishes, Invertebrate Animals, Nests and nidamental structures, Horns, Antlers, and the British Natural History are severally in a good state of preservation.

The space respectively allotted to each class of the Zoology is now so filled as to lead to the necessity, often referred to in the reports from that department, of removing and rearranging a proportion of the exhibited series, in order to make room for some additional specimen, the rarity or other quality of which may enforce its claim to public exhibition.

The specimens of Fossil Remains exhibited and in store are in a good state of preservation. The exhibited specimens are instructively arranged, and, in most instances, of easy access for scientific examination and comparison. Those which are stored in drawers, or in parts of the Museum not accessible to the public, are well arranged for study by scientific visitors.

The series of the Mineralogy is in a good state of preservation, and in an improved state of arrangement, display, and classification.

The additions in the year 1862 to the Department of Zoology are 13,129 in number, and some of the more interesting specimens are noticed in the report from that department. The *Troglodytes vellerosus*, Gray, discovered by Captain Burton in the Cameroon Mountains of W. Tropical Africa, is a specimen of the adult male, and forms an instructive addition to the present rich series of the Anthropoid apes.

Amongst the additions to the class Reptilia is a new tortoise, *Cyclemys Mouhotii*, discovered by M. Mouhot in the Lao Mountains of Cochin China.

The *Crocodilus Siamensis*, known to, and specified by Cuvier, from a skull in the Paris Museum, is now represented in the British Museum by a perfect example, as are also the new species, *Crocodilus pondicerianus*, *Jacare longiscutata*, and *J. ocellata*. A representative of a new genus (*Chloroscartes*) of lizard has been obtained from the Feejee Islands. Two remarkable forms of innocuous snakes, *Cercocalamus* and *Brachyurophis*, have been obtained from Central America; and from Africa a genus of viper (*Poecilostolus*), living on trees, which was discovered by Captain Burton in the Cameroon district. In the order *Batrachia* the Museum has acquired from Australia representatives of the genera *Platyplectrum* and *Cryptotis*, and several new species of *Limnodynastes*.

Of the additions to the class of *Fishes*, 1911 in number, during the past year, a few only are dried skins; the rest being entire animals, preserved in spirits. Dr. Günther has determined and described more than 150 new species; 128 examples of fishes have been added to the British Collection, a part of which were new to it, whilst the other species, now well exemplified, had been insufficiently represented by dried skins or deteriorated specimens.

Other valuable collections have been received from Lapland and Sweden, through a collector, Mr. Wheelwright; those specimens illustrate the differences between allied species occurring on the Continent as well as on the British Islands.

G. Y. Johnson, Esq., has continued to collect in the seas of Madeira; his collections are distinguished not only by the beautiful state of preservation of the specimens, but also by the discovery of several entirely new and highly interesting forms (*Setarches*, *Nesiarchus*, &c.).

From the Mediterranean several collections have been received through Dr. Gulia of Malta, and Dr. Th. Günther, besides some smaller additions.

Asia.—The fresh water fishes of the Holy Land are still desiderata in the National Collection.

An important collection of Tropical Asiatic fishes has been obtained from Dr. P. van Bleeker, containing typical specimens of the new species of Pharyngognathes and Anacanthines described by that ichthyologist in his forthcoming work on the ichthyology of the East Indian Archipelago.

A second collection, made by one of the members of the Prussian expedition to Siam and Japan, and acquired by the Museum, is not inferior to the former; almost all the rare forms described in the "Fauna Japonica," such as *Histiopterus*, *Velifer*, *Monocestris*, &c., and especially all the Chondropterygian fishes, are represented in it.

The last collection made by the lamented M. Mouhot in the interior of Siam contained several new forms, e. g., *Catopra*, &c.

Her Majesty's Consul at Formosa, R. Swinhoe, Esq., has commenced to collect and to send to the Museum the fishes of that island.

Africa.—The assistance of John Petherick, Esq., her Majesty's Consul at Khartoum, has been secured for procuring a complete series of the Fishes of the Nile, important not only for the naturalist, but also for the archæologist. The last collection sent by that gentleman to this country has been carefully examined, and every serviceable specimen was procured at a moderate price, so that the British Museum now possesses the finest collection of the fishes of that river.

The *Clarotes*, hitherto known from a single deformed example in the possession of Professor Hyrtl, of Vienna, is represented by specimens of all ages.

Several small collections of fresh water fishes have been received from the western coasts; nearly all the specimens contained in them are either entirely new, or but little known; some of the new species are extremely interesting, for instance, *Mormyrus Petersii*, with the lower lip produced into a long cone.

Australia.—Mr. G. Krefft, acting curator of the South Australian Museum at Sydney, has adopted the plan of having his specimens named in accordance with those preserved in European collections. For that purpose he transmits his duplicates at regular intervals to the British Museum, and, all the specimens being numbered, he receives the names in return; those specimens are of special particular value, inasmuch as the locality of each specimen has been noted. Rare species, as, e. g., *Atypichthys*, *Parma*, *Labrichthys*, have been received through this source.

America.—The fishes which have been received from the North American continent during the last year have come from the west coast.

A series of the viviparous fishes *Ditrematidæ* or *Holconoti*, in the most perfect state of preservation, has been obtained by the naturalist accompanying the British North American Boundary Commission; several undescribed species of *Salmonidæ* from the rivers from the western slope of the rocky mountains are in the same collection.

Dr. Ayres, of San Francisco, has commenced to send typical specimens of the species described by him; among them is a new form, *Parophrys Ayresii.*

A splendid collection of the fresh-water fishes of Guatemala and Vera Paz has been sent by Messrs. Godman and Salvin; 16 new species of Chromides have been already described, including representatives of two new genera, *Theraps* and *Petenia.*

In the foregoing observations on the additions of 1862 to the class of Fishes, it will be seen in how many parts of the world there are intelligent collectors, with a desire to co-operate with the Museum authorities in advancing Ichthyology. These remarks are also designed to indicate the extent of space which will be needed for the ulterior exhibition of the illustrations of the important and valuable class of fishes.

One of the most remarkable of fossil specimens recently discovered, *Archæopteryx macrurus*, Owen, has been secured, together with numerous other rare and unusually perfect fossils for the Department of Geology. These specimens are from the quarries of lithographic limestone at Solenhofen and Pappenheim, Bavaria. The *Archæopteryx*, besides the principal bones of the limbs and of part of the vertebral column, and furculum, exhibits impressions of feathers, including "primaries" and "under-coverts" of both wings, and the "rectrices" and quill-feathers of the tail. By the latter, the fossil bird chiefly differs from living birds; its tail, consisting of 20 vertebræ, is longer than the trunk, and a pair of feathers diverge from each of the vertebræ. The matrix of the *Archæopteryx* belongs to the upper Oolite period, and is the most ancient in which fossil remains of a bird have, hitherto, been discovered. The class, however, is indicated by foot-prints in older secondary formations.

Rare and acceptable additions have accrued to all the Departments of Natural History through the International Exhibition of 1862.

The Geological and Mineralogical Departments have been enriched by a highly instructive and valuable collection of specimens, plans, and maps, graciously presented by Her Majesty, at whose disposal they had been placed by the Imperial Austrian Government. They formed part of the series in the Austrian Department of the International Exhibition.

Amongst these specimens may be particularised an extensive series of characteristic examples of coal, lignite, and allied forms of petrified and carbonised vegetable matters from the several carboniferous strata in the Austrian dominions. Such a series will form an important element in a Geological Department, properly so called, should such department be hereafter associated with the collections of Fossil Remains (Palæontology) in the Natural History Departments of the British Museum.

The space which these specimens of the coal of a single continental country occupied in the Austrian Department of the International Exhibition—specimens illustrative of a Geological subject replete with interest in its economical relations to a manufacturing and commercial country—exemplifies the data and considerations on which exhibition space was estimated in the Superintendent's Report of 16th March, 1859, for the combined Geological and Palæontological Departments of the National Museum of Natural History. The instructive series of Crystals accompanying the above donation of Geological specimens, is noticed in the Report from the Department of Mineralogy.

From the Spanish Department of the International Exhibition have been received, by donation from the Commissioners, specimens of marbles from Cordova, of Anglesite from Toledo, and of Meerschaum from Vallicas.

From the Canadian Department the Mineralogy has received, by donation from Professor Sterry Hunt, a series of characteristic specimens from that province.

From the Australian Department the Zoology has received a series of dried and stuffed Fishes, mostly of large size, including the Histiopterus, with some rare sharks.

The number of additional specimens to the Natural History, during the year 1862, is 28,273, of which 13,129 are registered in the department of Zoology, 3144 in the department of Geology, and 1200 in the department of Mineralogy.

Richard Owen.

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White, M. C.—Discovery of Microscopic Organisms in the Palæozoic Rocks of New York. A. N. H. 3 ser. x. p. 160.

Whitfield, R. P.—Description of *Lingula polita*. Sill. Journ. xxxiv. p. 136.

Wilkinson, J. T. and J. Whitaker.—The Burnley Coal Field and its Fossil Contents. Rep. Brit. Assoc. for 1861, p. 135.

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Wright, T.—On the Fossil *Echinidæ* of Malta. Quart. J. Geol. Soc. xix. p. 277.

Würtemberger, F. J. and T.—Verzeichniss von fossilen Pflanzerresten aus der Tertiär-Gebilden des Klettgaues. Bronn u. Leonh. Jahrb. 1862. p. 719.

Zejszner, L.—Sur le *Pachyrisma Beaumonti*. Bull. d. l. Soc. Geol. d. France, 2nd ser. xix. p. 529. (Plate.)

LXII.—Phanerogamia.

Alefeldt, F.—Ueber die Zeichen der Lebensdauer der Pflanzen. Bonpl. 1862. p. 200. Referring to the symbols employed for brevity, &c.

——— Namensänderung zweir Leguminosen-Gattungen. Ibid. p. 264. The name *Benthamantha* is substituted for *Cracca* (section of *Tephrosia ?*) and *Seemanantha* for *Macronyx* of Dalzell.

——— Ueber Formeln der Blüthentheile. Ibid. p. 275. Formulas are proposed expressing, briefly, floral characters, &c.

——— Die Gattung *Faba* in ihren Culturvarietäten. Ibid. p. 347. With descriptions of the seeds of some 40 varieties of the common Bean.

——— Ein häufig unbeachtetes Axiom der "Art." Bot. Zeit. 1862. p. 69. In favour of the view that the *amount* of difference is a factor, over and above permanency from generation to generation, in determining what is of specific value.

——— Nachträge zu Meiner Monographie der Pyrolaceen. Ibid. p. 217. Supplementary observations to the author's paper in the Linnæa, 1856.

——— Ueber die Stipulae bei *Lotus*, &c. Ibid p. 220. The "stipules" of *Lotus* and *Tetragonolobus*, regarded as leaflets by Irmisch, Alefeldt shows to be truly stipular; the glands at their base (stipules of Irmisch) being appendages of the same.

Alefedt, F.—Ueber die amphicarpen Vicieen. Ibid. p. 362. Notes few varieties with hypogæan flowers; *Orobus setifolius* and *Vicia lutea*, as pointed out by Smith, amongst the rest.

——— In denselben Blüthen normaliter die Antheren zum Theil nach innen, zum Theil nach aussen aufspringend. Ibid. p. 339. *Fagopyrum esculentum* and *Polygonum orientale* are stated to have the anthers of the outer verticil of stamens dehiscing introrsely, of the inner verticil extrorsely.

Allemao, F. F. e M. F.—Trabalhos da Commissão Scientifica de Exploraçao—Secçao botanica, Fasc. 1. Rio, 1862. With figures and description of a new genus of Anacardiaceae (*Myracrodruon*), of a *Sterculia* (*Pterygota*) from Ceará, &c.

Andersson, N. J.—Ueber die Vegetation der Galapagos-Inseln. Linnaea. xv. p. 571. Based on the author's observations made in a visit to the Islands in 1852, on board the Swedish Frigate "Eugenie," and upon those of previous writers. (v. N. H. R. iii. p. 367.)

Ardoino, H.—Catalogue des Plantes Vasculaires qui croissent spontanément aux environs de Menton et de Monaco, avec l'indication des principales espèces de Nice, &c. Turin, 1862, 8vo. pp. 46. In the prefatory essay the Flora of Menton is compared with the Floras of Gênes, Toulon, Marseilles, Turin, Paris, London, and Canary Islands. The total number of species, including vascular cryptogams, in the Menton Flora is 1000. Localities of the rarer species are given.

Auerswald, B.—Botanische Unterhaltungen zum Verständniss der heimatlichen Flora. Ed. ii. Leipzic, 1862.

Auvergne, L'Abbé.—Sur la flore de Morestel (Isère). Bull. Soc. Bot. vii. p. 599.

Baillet, C. et E. Timbal-Lagrave.—Essai monographique sur les espèces du genre *Galium* des environs de Toulouse. Mem. Ac. Toul. Ve Sér. vi. p. 217. The authors find about 20 "species" of *Galium* near Toulouse, three of which are here described as novelties. Two forms believed to be hybrid also occur; they are *E. vero-dumetorum* and *E. dumetoro-verum*. Truly do these gentlemen say, in their introductory observations, "* * la delimitation des espèces, telle qu'elle avait d'abord été indiquée par Linné dans son immortel ouvrages a-t-elle été peu à peu modifiée et même presque entièrement abandonée. Non-seulement ses variétés sont aujourd'hui pour la plupart élevées au rang d'espèces, mais encore on n'a pas craint de créer des espèces nouvelles avec des formes que ses contemporains ou ses élèves n'eussent pas osé classer parmi les variétés."

Baillon, H.—Études organogéniques sur quelques genres de Byttnériacées. Adans. ii. p. 166.

An attempt to ascertain how far the development of the flower differs in Byttneriaceae and Malvaceae, and whether, in the former Order, plants are not included differing more widely from each other than from certain Malvaceae. The evolution of the flower is described in several genera.

Baillon, H.—Études sur la Ficaire et l'Hépatique. Ibid. ii. p. 202.

——— Species Euphorbiacearum Neo-Caledonicae. Ibid. p. 211. *Bocquillonia*, a new genus, is described.

——— Remarques generales sur les Phyllanthées de la Nouvelle-Calédonie. Ibid. p. 242. *Menarda*, Comm. and *Leptonema*, Juss. are reduced to the genus *Phyllanthus*.

——— Organogénie florale des *Acronychia*. Ibid. p. 253. Study of the organogeny of *Acronychia* leads M. Baillon to refer it to Diosmeae rather than Zanthoxyleae, or to Aurantiaceae, to which he himself had previously referred it.

——— Sur l'organisation florale du *Condalia microphylla*. Ibid. p. 257. It is shown that in *Condalia* the pistil is monocarpellary, the two apparent cells arising from the intrusion of the ventral suture. *Zizyphus*, with bilocular ovary, is truly dicarpellary.

——— Description d'un nouveau genre de la famille des Humiriacées. Ibid. p. 262. The new genus is named *Aubrya*, from West Tropical Africa.

——— Remarques sur l'organisation des Berbéridées. Ibid. p. 268. 1. Value of the genus *Aceranthus* (reduced to *Epimedium*); 2. Division of *Epimedium* into sections; 3. On pentamerous flowers of *Epimedium*, and (4) of *Berberis*; 5. The anthers (and their dehiscence) of Berberideae; 6. The gynœcium of *Epimedium*; 7. The pistil of *Jeffersonia*; 8. Of *Leontice*; 9. The floral symmetry of *Leontice*; 10. Of *Jeffersonia*; 11. The Andrœcium of *Podophyllum*; 12. The ovules of Berberideae; 13. Value of the Order *Nandineae*; 14. The aril of certain Berberideae; 15. On the affinities of Berberideae and Papaveraceae; 16. Development of the leaves of some Berberideae.

——— Sur une Protéacée et une Laurinée polycarpellées. Ibid. p. 292. *Lambertia formosa* with 4 and a *Sassafras* with 2 or 3 carpels.

——— Étude d'une Crucifère a fleurs monstrueuses. Ibid. 306. With remarks on teratological evidence in settling the morphological value of organs.

——— Note sur le *Burasaia*. Ibid. p. 316.

——— Sur un nouveau genre de la famille des Myrtacées. Ibid. p. 323. *Bœckea camphorata*, R. Br. forms the type of the genus *Eremopyxis*

——— Mémoire sur les Loranthacées. Ibid. ii. p. 330. In this essay the author discusses the character of the so-called "calyx" of Santalaceae, Olacaceae, Loranthaceae, and their allies, also of Compositae, Valerianeae, and some other Orders with inferior ovaries. These are regarded as being truly asepalous, the ovary becoming inferior from the adhesion of an external annular, or discoid development of the axis. M. Baillon's arguments rest upon the order of development of the investing organs of the flower, and the appearance of the parts of the verticil simultaneously, as a continuous ring, immediately exterior to the staminal whorl, from which he concludes it to be corolline. Umbelliferae, Araliaceae, &c., possess both calyx and corolla, as shown by their organogeny. Two new genera are described in foot-notes, viz.:—*Stolidia*, founded upon a Mauritian plant, and *Lavallea*, upon *Strombosia Zeylanica*, Gard. and a Manila plant of Cuming's. M. Baillon unites under Loranthaceae, the Orders Santalaceae, Olacaceae, and allied groups; the limits, secondary divisions, and affinities of which he proposes to treat in a future essay.

BALFOUR, J. H.—Description of a New Species of *Clerodendron* from old Calabar, which flowered in 1861, in the Royal Botanic Garden of Edinburgh. With 1 pl. Ed. Phil. Journ. N.S. xx. (Ext. pp. 4).

——— On the Structure of the Bark of *Araucaria imbricata*, with special reference to Palaeontology. R. S. Proc. Ed. iv. 577.

——— Notes of a Trip to the North of Italy and Chamcuni in 1861. Trans. Bot. Soc. Ed. vii. p. 255. A list of the plants is given.

BAPTISTA, J. E.—Discussão dos caracteres distinctivos da Familia das Paronychiaceas; Classificaçao e diagnose dos generos que a compoem. Mem. Ac. Lisb. 1857.

BASINER, T.—Schädlicher Einfluss des Schnees auf Bäume und höhere Sträuche. Ferner auch einige phyto-klimatologische Bemerkungen. Mosc. Bull. 1861, v. p. 481.

BAXTER, H. F.—Does Magnetism possess any Influence over Organic Forces? Trans. Bot. Soc. Ed. p. 312.

BELHOMME, M.—Note sur les bourgeons reproducteurs du *Ranunculus Lingua*. Bull. Soc. Bot. ix. p. 241. On the production of axillary hybernal buds.

BENTHAM, G.—Florae brasiliensis Papilionacearum Tribus ix. Dalbergieae et Tribus x. Sophoreae. (Fasc. xxix. Martius; Flora Brasiliensis). Lipsiae. 1862. Tabb. 57—127. The new genera described are *Tipuana*, (formerly a section of *Machærium*), *Pœcilanthe*, (near *Pterocarpus*), *Hymenolobium* (resembling *Andira amazonum*, excepting in the legume), and *Monopteryx* of Spruce (*Sophoreae*).

——— On African Anonaceae. Linn. Trans. xxiii. p. 463, with 5 Plates. Nearly 40 African species are now known, all excepting one confined to that Continent. One species, *Anona Senegalensis*, extends across it, covering immense tracts of country. Three genera are peculiar to Africa and its Islands, and 6 to Asia and Africa. Besides *Anona*, *Xylopia* is chiefly an American genus, like *Anona* shared with Africa, unlike it also with Asia. The species are described, including several new ones, amongst the rest two new *Monodoras*.

BENTHAM, G.—Notes on Caryophylleae, Portulaceae, and some allied Orders. Linn. Jour. Bot. vi. p. 455. Caryophylleae are distributed into the following tribes, viz. *Sileneae*, exstipulate, with a gamosepalous calyx, hypogynous stamens and free styles; *Alsineae*, scarious stipules only in *Spergula* and *Spergularia*, free sepals, hypogynous or slightly perigynous stamens and free styles; and *Polycarpææ*, stipulate, with free sepals, stamens as in *Alsineae*, and combined styles. Portulaceae differ from Caryophylleae in the anisomery of the floral whorls; the sepals usually 2, the petals 3 to 7, or 8. Mollugineae it is proposed to place in Monochlamydeae, near Phytolaccaceae; and Paronychiaceae (limited to genera with 1-ovulate ovary and utricular fruit) near Amarantaceae.

Critical observations follow upon the genera, &c., of Caryophylleae, Portulaceae, and Mollugineae. *Heliosperma* and *Elisanthe* are reduced to *Silene; Melandrium*, *Viscaria*, *Agrostemma* and *Petrocoptis* to *Lychnis*. The numerous genera of exstipulate *Alsineae* are reduced to 11, viz. *Holosteum*, L., *Cerastium*, L., *Stellaria*, L., *Brachystemma*, Don, *Arenaria*, L., *Buffonia*, L., *Colobanthus*, Bartl., *Thylacospermum*, Fenzl, *Schiedea*, Ch. and Sch., and *Queria*, Bartl.

BENTHAM G.—Notes on Malvaceae and Sterculiaceae. Ibid. p. 97. Malvaceae. An essential character of this Order as distinguished from Sterculiaceae, Mr. Bentham finds in their one-celled anthers—one-celled not by abortion but confluence from an early stage of development. *Bombaceae* are included in Malvaceae, agreeing in their anthers, soft wood, cottony seeds, &c. A synopsis of the genera is given, followed by extended remarks upon each. *Scleronema* is a new genus of the subtribe Matisieae (Bombaceae), founded on a Brazilian plant of Spruce's (No. 2548) near *Hampea*. With Sterculiaceae proper, Buettneriaceae are united; no tangible characters being available for their discrimination. A synopsis and critical notices of the genera are given. *Dicellostyles* is a new genus based on *Kydia axillaris* of Thwaites, and *Cheirolæna* on a Mauritius plant, near *Dombeya*. Under *Glossostemon*, are observations on the homologies of "petiolar glands,"—referred by the author to a transverse 'dédoublement,'—and their relation to the anthers, especially of the tribe *Buettnerieae*, in which the 'petiolar gland of the petal-leaf' forms the apexof the hood connivent over the staminal column.

BENTHAM, G.—On *Inocarpus*. Ibid. vi. 146. This genus, referred to Sapotaceae and Hernandieae is found by Messrs. Hooker and Bentham to be a true *Leguminosea*, near *Etaballia*, a tropical American genus of Mr. Bentham's, which possibly may prove identical with *Bocoa*, of Aublet. Technical characters of the three genera are given.

BENTHAM, G. et J. D. HOOKER.—Genera Plantarum ad Exemplaria imprimis in herbariis Kewensibus servata definita. Vol. I.

pars 1, 8vo. pp. 454. Ranunculaceae to Connaraceae. A Conspectus of the Natural Orders of Polypetalous Dicotyledons is prefixed to the volume. Under each Order is given a 'Conspectus Generum;' the 'Formae abnormes,' and 'Genera affinia aut exclusa v. dubia' are also enumerated. The new genera here described are 47 in number. They are—*Synclisia*, *Triclisia*, *Microclisia*, *Adeliopsis* (Menispermaceae); *Porphyrocodon*, *Ammosperma*, *Notothlaspi* (Cruciferae); *Peridiscus* (Bixineae); *Endodesmia* (Vismieae); *Pelliciera*, Pl. and Tr. (Ternströmiaceae); *Dicellostyles*, *Coelostegia* (Malvaceae); *Cheirolæna* (Sterculiaceae); *Aneutophus*, *Hebepetalum* (Erythroxyleae); *Leptothyrsa* (Cusparieae); *Hyptiandra* (Boronieae); *Medicosma*, *Pentaceras*, *Decatropis*, *Polyaster*, *Megastigma* (Zanthoxyleae); *Mannia*, *Picrolemma*, *Cneoridium* (Simarubeae); *Wallacea*, Spruce (Luxemburgieae); *Crepidospermum* (Burseraceae); *Beddomea* (Trichilieae); *Leptaulus*, *Phlebocalymna*, Hb. Griff. (Icacineae); *Tripterygium* (Celastreae); *Nesiota*, *Lasiodiscus* (Rhamneae); *Castanella*, Spruce, *Diploglottis*, *Dittelasma*, *Eriocœlum*, *Chytranthus*, *Glenniea*, *Akania* (Sapindaceae); *Loxopterygium*, *Euroschinus*, *Trichoscypha*, *Drimycarpus*, *Drepanospermum* (*Cyrtospermum* of Bentham in Kew Journ.), (Anacardieae); *Tæniochlaena*, *Ellipanthus* (Connaraceae).

Berg, O.—Die Balsamodendron-Arten der Berliner Herbarien. Bot. Z. 1862, p. 158. The new genus *Balsamophloeos* is founded on *Amyris Kataf* of Forskal. *Balsamodendron* is re-described and the species enumerated.

Besnou et B. Lachenée.—Catalogue raisonné des plantes vasculaires de l'arrondissement de Cherbourg. Cherbourg, 8vo. pp. 257, 1862.

Black, A. A.—Systematisches Verzeichniss aller seit Thunberg in Japan gesammelten Pflanzen. Bonpl. 1862, p. 88. A reprint from the list appended to Mr. Hodgson's Japan, with additions and corrections.

Bocquillon, H.—Description d'un genre nouveau de la Famille des Verbenacées. Adans. ii. p. 249, with fig. *Baillonia*, n. g. based on a Paraguay plant of M. Weddell's.

——— Observations sur les genres *Oxera* et *Amethystea*: leur organisation comparée a celle du *Clerodendron*. Ibid. p. 294. Shewing *Oxera* to occupy a position intermediate between Labiatae and Verbenaceae, and that *Amethystea* belongs to the latter rather than the former Order, with which it has been hitherto associated.

Böhm, J.—Beiträge zur näheren Kenntniss der Genesis und Function von Pflanzen-Farbstoffen. Wien. Sitzb. xlv. p. 399.

Boissier, E.—Prodromus Systematis Naturalis Regni vegetabilis. Vol. xx. Sect. post., Fasc. i. *Euphorbiaceae*, Subordo *Euphorbieae*, including the genera *Pedilanthus*, *Euphorbia*, *Synadenium*, and *Anthostema*. *Euphorbia* contains about 700 species.

Boot, F.—Illustrations of the genus *Carex*. Pt. iii. Tab. 311-411. London, 1862. The variable species are well illustrated. Eight plates are devoted to the varieties of *Carex filicina*, four to *C. Jamesoni*, five to *C. Boryana*, *C. alpina* and *C. adusta*, six to *C. straminea*, and *C. vulpinoidea.*

Boussingault, M.—Sur la nature des Gaz produits pendant la décomposition de l'acide carbonique par les feuilles exposées a la lumière. A. Sc. Nat. iv. ser. xvi. p. 5 and C. Rend. liii. p. 862. Numerous analyses are given of the gases given off by plants under the influence of light, precautions having been taken to prevent the air dissolved in the water in which the experiments were conducted, or confined in the tissues of the plant, from vitiating the results. It was found that when exposed to the sun, an appreciable amount of the oxide of carbon (and also of the proto-carburet of hydrogen) was given off. M. Boussingault asks if the insalubrity of marshy countries may not be due to the emanation of this noxious gas.

Bouteille, M.—Note sur l'Orobanche-du-lierre. Bull. Soc. Vol. ix. p. 340. The seeds are supposed to require "une incubation" of three years before germination. Vaucher, however, showed that *Orobanche* might vegetate two or three years without throwing up a flowering stem.

Braun, A.—Ueber abnorme Blattbildung von *Irina glabra* im vergleich mit analogen Vorkommnissen bei anderen Pflanzen. Konigsb. Verh. Nat. (Bot.) Ext. pp. 5, with 1 plate.

Irina glabra is a Sapindaceous tree of the Eastern Archipelago; a variety of which, with the leaflets pinnatifidly incised, has been distinguished by Miquel as var. *dissecta.* Prof. Braun's observations apply to specimens of this variety preserved in Hornschuch's herbarium, in which one side of the leaf-lamina is entire and but slightly serrate above and penni-veined, while the other is cut up into pinnatifid lobes, and in part reduced almost to the principal vascular branches, which present a tendril-like appearance. This abnormal leaf is compared with other forms (abnormal and normal) occurring in various species. A long description is given of the accession of a compound character in the leaves of *Gleditschia triacanthos.*

——— Appendix plantarum novarum et minus cognitarum quae in horto regio botanico Berolinensi coluntur. Mart. 1862, pp. 14. Including a minute description of *Festuca Brückmanni*, supposed to be a hybrid between *F. gigantea* and *Lolium perenne*; a re-distribution of the species of the genera *Asarum* and *Helleborus*; and statistics of an examination of numerous flowers of *Caelebogyne ilicifolia.* In the female flowers of the latter no polleniferous stamens or staminodia were to be found, as was also the case in ten flowers examined about the same time, in the Leipsic garden by Mettenius. (*Vide*, also, A. Sc. Nat. ser. 4. xvi. p. 77.)

Braun, A.—Ueber d. variiren der Blattstellung an d. Stämmen von *Araucaria brasiliensis.* Berl. Monatsb. 1861, p. 267.

——— Wirkung d. diesjahrigen Spätfröste auf die Blätter der gemeinen Rosskastanie (Aesculus). Ibid. p. 691.

Brongniart, A.—Sur une nouveau genre de la Famille des Cyclanthées. A. S. N. ser. iv. xv. p. 360. *Ludovia,* from French Guiana.

Brongniart, A. and A. **Gris**.—Notice sur les Saxifragées- Cunoniées de la Nouvelle-Calédonie. Bull. Soc. Bot. ix. p. 67.

Five new species of *Cunonia* are described from New Caledonia.

A new genus (*Pancheria*) with flowers unisexual by abortion, of which seven species have been received. The flowers are diclinous by abortion.

Three new species of *Geissois,* four of *Codia,* and two of *Weinmannia* and of *Spiræanthemum,* are also described.

Brücke, E.—Das Verhalten der sogenannten Protoplasmaströme in den Brennhaaren von *Urtica urens* gegen die Schlage des Magnetelektromotors. Wien. Sitzb. xlvi. p. 35.

Buchenau, Fr.—*Cotula coronopifolia,* L. Ein Beitrag zur Naturgeschichte der einheimischen Gewächse. Bot. Zeit. 1862, pp. 17, 25. With figs.

——— Kleinere Original-Mittheilung. Ibid. p. 127. On the occurrence of wild double-flowered *Ranunculus acris.*

——— Der Blüthenstand von *Empetrum.* Ibid. with figs. A careful account of the relation of the flowers and 1-2-3 flowered inflorescences to the axis and subtending bracts.

——— Einige Beobachtungen aus dem Gebiete der Pflanzen Teratologie. Ibid. p. 305. 1. *Daucus Carota* with spirally twisted roots; 2. *Ionopsidium acaule* with a seventh stamen; 3. *Dédoublement* of petals in *Brassica;* 4. abnormal flower of *Periploca graeca*; 5. *Parnassia* with partial metamorphosis of a staminodium into a carpel, and another with two ovaries; 6. Abnormal forms of *Plantago major.*

——— Berichtigung zu dem Aufsatze "Einige Beobachtungen aus d. Gebiete der Pflanzen-Teratologie." Bot. Z. 1862, p. 438.

Buckley, S. B.—Descriptions of New Plants from Texas. Proc. Ac. Phil. Dec. 1861 and Jan. 1862. Dr. A. Gray has shown that all the genera described as new in this paper are mistakes, as are most of the supposed new species. The genera are *Elidurandia* (*Fugosia*), *Hoopesia* (made up of *Cercidium* and *Acacia*), *Margacola* (*Trichocoronis*), *Linsecomia* (*Helianthus*), and *Phileozera* (*Hymenoxys*). These are taken from Prof. A. Gray's notice.

Bunge, A.—Anabasearum revisio. Mem. Ac. Petrop. vii. ser. iv. Ext. pp. 102, 3 plates; and A. S. Nat. iv. Ser. xvi. p. 346. Of the 16 genera fully treated of in this monograph, and which constitute the subtribe Anabaseae (characterised by a vertical seed) of the Salsoleae, 4 are new; viz.: *Petrosimonia, Halarchon, Gamanthus,* and *Halotis.* We subjoin explanation of the figures of anthers on plate I. (omitted in the separate copies) furnished by Prof. Bunge—

Halocharitis—1. *hispidae;* 2. *sulfureae;* 3. *violaceae;* 4. *clavatae.*

Halimocnemidis—5. *sclerospermae;* 6. *Kirilowii;* 7. *pilosae;* 8. *villosae;* 9. *macrantherae;* 10. *mollissimae.*

Halotidis—11. *occultae.*

Halarchontis—12. *vesiculosi.*

Gamanthi—13. *commixti;* 14. *gamocarpi;* 15. *pilosi.*

Halanthii—16. 17. *Kulpiani;* 18. *mamanensis;* 19-22. *rarifolii;* 23. *purpurei.*

Girgensohniae—24. ovarii apex (auctus).

Halarchontis—25. pistillum virgineum auctum.

Idem foecundatum, auctum.

Bureau, E.—Remarques sur la Classification des Bignoniacées, et observations sur les genres *Radermachera* et *Stereospermum.* Baillon, Adans. ii. p. 182.

Bureau's observations apply primarily to *Radermachera* of Zollinger (No. 3141) which is described and analyses figured. It is referred to Catalpeae near *Stereospermum.* Some critical notes are given upon the subtribes of *Bignoneae.*

——— Note sur les Bignoniacées de la Nouvelle-Calédonie. Bull. Soc. Bot. ix. p. 162. *Deplanchea* of Vieillard (*vide infra*) is regarded as truly Bignoniaceous. A further account is given of its structure.

Cantani, A.—Sullo sviluppo della cosi detta membrana secondaria della cellula vegetale e sulle sue varie modificazioni. Soc. ital. Sc. iii. p. 419. M. Cantani is of opinion that the lamination of the secondary deposits of the cell-wall is due to alternating periods of moisture and dryness. The function of the pore-canals, their form, and the relations of the opposed canals of contiguous cells, the origin of vessels, &c., are discussed.

Carrière.—*Amygdalopsis Lindleyi.* Rev. Hort. 1862, p. 91. Description with figure. This is the *Prunus triloba* of Lindley.

——— Sur les facultés germinatives des graines. Ibid. p. 288. *Apropos* of *Chamaerops Martiana,* upon the relation of the state of development and age of the seed, and the plant which it produces.

Carrington, B.—Notes on Cyperaceae. Trans. Bot. Soc. Ed. 1862. 1. *Carex Grahami;* 2. *Eleocharis palustris* and its allies.

Caruel, T.—Prodomo della Flora Toscana. Fasc. ii. Caliciflore polipetale. *Staphyleaceae* to *Caprifoliaceae,* pp. 129-304.

Caspary, R.—Ueber die Gefässbündel der Pflanzen. Vorlaufige Mittheilung. Berl. Monatsb. 1862, p. 448. (*Vide* N. H. R. 1863. p. 364.)

——— Eine kanadische Pappel vom Blitz getroffen. Königsb. Schrift. ii. p. 41. Attention is categorically directed to several points of which observers should be mindful in reporting upon trees struck by lightning.

Caspary, R.—*Orobanche Cirsii-oleracei.* Ibid. p. 46. A new form described in detail and figured, parasitic on *Cirsium oleraceum.*

——— *Nuphar luteum,* L. var. *rubropetalum.* Ibid. p. 49. Its occurrence in the Lyck-see.

——— Vergrünungen der Blüthe des Weissen Klee's. Ibid. p. 51. With numerous figures. A minute account of a monstrous form of *Trifolium repens,* with special reference to the bearing of the case upon the morphological relations of the parts of the ovule. The funiculus with the integuments appear to be in this instance the equivalents of a leaflet, the petiolule or midrib of which answers to the funiculus and its hollow expansion to the integuments. The nucleus is a new formation analogous to a sprout. Applying this view to plants with axile placentation, Dr. Caspary holds that in *Primula,* the leaves, five in number, constituting the pistil, are pro-carpels, the true carpels being each reduced to funiculus and integuments of as many ovules. This view he considers supported by the *taxis* of the ovules upon the central placenta.

——— *Aldrovandia vesiculosa.* Bot. Z. 1862. p. 185, with one plate. Supplementary to the author's previous essay on this species (Bot. Z. 1859. p. 117.) Information is still required upon the fruit, and the way in which the seeds are liberated; their structure and germination; the irritability of the leaves; the culture of the plant; do the winter-buds float or sink in winter? the duration and development of the flower.

Castagne, E.—Catalogue des plantes qui croissent naturellement dans le département des Bouches-du-Rhône. Marseilles, 1862. Including nearly 1900 vascular species.

Cauvet, D.—Études sur le role des racines dans l'absorption et l'excrétion. (Strasbourg, 1861). A. S. N. ser. iv. xv. p. 320.

Chabert, A.—Esquisse de la végétation de la Savoie. Bull. Soc. Bot. vi. p. 565.

Chatin.—Études anatomiques et physiologiques sur les Sucs nourriciers des Végétaux. De l'existence, dans tous les tissus en voie de formation ou de végétation active, d'un principe immédiat neutre, azoté, non coagulable et d'abord incolore, mais se colorant en brun dans la plante morte ou affaiblie. Bull. Soc. Bot. vii. p. 882.

——— Recherches sur le développement, la structure et les Fonctions des tissus de l'anthère. Bull. Soc. Bot. ix. p. 461. With special reference to the endothecium.

Clos, D.—Deuxième fascicule d'observations tératologiques. Ext. Mém. Ac. Toul. 5e ser. vi. 1862. The several items are: 1. Alternate leaves passing into a verticil in *Veronica latifolia.* 2. *Anagallis collina* with leaves in verticils of 3 or 4, distinct or connate in pairs. 3. Connation, &c., of leaves in a fasciate lentil. 4. Monstrous trefoil. 5. *Anemone Coronaria,* with an involucre of from 3 to 5 bracts, of which one resembled the sepals. 6. *Tropæolum tricolor,* destitute of a spur. 7. Quaternary *peloria* of *Salvia grandi-*

flora. 8. *Peloria* of *Linaria spuria.* 9. Multiplication of floral organs in *Bignonia capreolata.* 10. The relation of the *Rutaceae* and *Zygophylleae* confirmed by an abnormal flower of Rue. 11. *Delphinium dictyocarpum* with hypertrophied carpels. 12. On the style in *Caryophylleae.* 13. Median prolification of a Poppy.

Clos, D.—Révision d'une des sections du genre *Sideritis.* A. S. N. ser. iv. xvi. p. 78. The section *Marrubiastrum*, Benth.—*Petiolatae*, Clos, with a synopsis of the 8 species.

——— Examen critique de quelques charactères d'espèces. Bull. Soc. Bot. ix. p. 6. Upon (1) *Stellaria neglecta*, a perennial plant; (2) a monoecious specimen of *Urtica dioica;* (3) *Althæa ficifolia*, doubtfully different from *A. rosea.*

——— Discussion de quelques points de Glossologie botanique. Bull. Soc. Bot. ix. p. 355. The terms discussed are *Bourgeon*, *Bulbille*, *Propagule.*

——— Réponse aux Objections de M. Planchon sur la nature des pièces du calice chez les Cistinées. Ibid. p. 519. Maintaining his opinion that the two outer pieces of the calyx are formed of two stipules.

Cocks, W. P.—Contributions to the Flora of Falmouth. Rep. Corn. Polyt. Soc. 1861, p. 1. Grasses only: not a scientific paper.

Cohn, F.—Ueber die contractilen Staubfäden der Disteln. Wiss. Zool. Zeitsch. xii. Hft. 3, and Flora, 1862, p. 583. On the histological changes of the cells of the filaments, accompanying contraction; the relation of the irritability to the electric current, and to similar phenomena in the lower animals.

Cosson, E.—Note sur la stipule et la préfeuille dans le genre *Potamogeton*, et quelques considerations sur ces organes dans les autres monocotylées. Bull. Soc. Bot. vii. p. 715. The author in his resumé says: 1. The stipule of *Potamogeton*, as that of Gramineae and Cyperaceae, appears to be formed of a single organ, and not of a pair united by their edges: 2. This stipule is bi-nerved or not according to whether it is exposed or not to a pressure from without inwards, or from within outwards: 3. The essential character of the '*prefeuille*' (hypsophyllary leaf) is its position: 4. Its degree of development bears proportion to its function as a protective organ.

——— Note sur quelques espèces nouvelles d'Algérie. Bull. Soc. Bot. ix. pp. 167, 295. With a figure of *Anabasis aretioides.*

——— Considérations générales sur l'Algérie. Ibid. p. 498. With some interesting observations upon the principal regions of climate and vegetation, especially of the Algerian Sahara.

Crepin, F.—*Elodea canadensis*, Rich. Bull. Soc. Bot. Belg. i. p. 33. On its occurrence in Belgium.

——— La Florule des environs de Han-sur-Lesse. Ib. p. 41.

——— Petites annotations à la flore de la Belgique. Ib. p. 69.

Crepin, F.—Notes sur quelques plantes rares ou critiques de la Belgique. Fasc. ii. Bull. Belg. Acad. xiv. p. 76. 1862.

Cutanda, V.—Flora compendiada de Madrid y sa provincia o descripcion sucinta de las Plantas vasculares que spontaneamente crecen en este territorio. Madrid, 1861, 8vo. pp. 759.

Daniell, W. F.—Notes on some Chinese Condiments obtained from the Zanthoxylaceae. A. N. H. ser. iii. pp. 10, 195. Including descriptions, by Mr. Bennett, of two new E. Asiatic species of *Zanthoxylum.*

Darwin, Charles.—On various Contrivances by which British and Foreign Orchids are fertilised by Insects, and the good effects of intercrossing. (*vide* N. H. R. 1862, p. 371.)

——— On the three remarkable sexual forms of *Catasetum tridentatum*, an Orchid in the possession of the Linnean Society. Linn. Proc. Bot. vi. p. 151. Shewing *C. tridentatum*, *Monachanthus viridis*, and *Myanthus barbatus* to be three sexually diverse forms of the same species, viz., *C. tridentatum;* the male with well developed pollinia, liberated by the elasticity of the caudicles on the rupture of the membrane of the rostellum surrounding their disk. This rupture is shown to be occasioned by the stimulus of a touch conveyed to the rostellum by the curved arms, called by Mr. Darwin *antennae,* projecting in front of the column. The stigmatic surface is not viscid, and the ovules are more or less atrophied. *Monachanthus* is the female form, with rudimentary pollinia, and destitute of antennae, but with well developed ovary and viscid stigma. *Myanthus*, the hermaphrodite, having the column erect, not inverted as in the other forms, and the labellum remarkably different: with smaller pollinia than *Catasetum* and stigmatic cavity intermediate in size between the two other forms.

——— On the two forms, or Dimorphic Condition, in the species of *Primula,* and on their remarkable sexual relations. Linn. Journ. Bot. vi. p. 77. (*vide* N. H. R. 1862, p. 235.)

Decaisne, J.—Rapport sur un Mémoire de M. Weddell, relatif au *Cynomorium coccineum.* A. Sc. N. iv. ser. xv. p. 103.

Decaisne, J. et C. Naudin.—Manuel de l'amateur des Jardins. Part 1. Paris, 1862, 8vo. pp. 706. A large portion of this volume is occupied by chapters on Vegetable Structure and Physiology in special relation to Horticulture.

De Candolle, A.—Prodromus Systematis naturalis Regni Vegetabilis, Vol. xv. Sect. post., Fasc. i. *Vide* Boissier.

——— Note sur un nouveau Caractère observè dans le fruit des Chênes, et sur la meilleure division à adopter pour le genre *Quercus.* Bibl. Univ., Oct. 1862. M. De Candolle finds the position of the atrophied ovules in the species of *Quercus* useful in affording sectional characters, especially (together with the period occupied in the maturation of the fruit, whether one or two seasons) of the group *Lepidobalanus.* At the same time species closely allied in all other respects differ in this, some having the aborted ovules superior, some inferior. *Q. virens* is stated to present the singular feature of the radicle embedded in a homogeneous mass,—the two consolidated cotyledons.

De Candolle, A.—Étude sur l'espèce à l'occasion d'une révision de la Famille des Cupulifères. Bibl. Univ., Nov. 1862. (*vide* N. H. R. 1863, p. 189.)

Delavaud, C.—Sur une anomalie observée sur un *Bellis*. Bull. Soc. Bot. ix. p. 471.

Des Moulins, C.—De la Connaissance des Fruits et des Graines. Act. Bordeaux, 1862. (Ext. pp. 32.) A popular essay on Carpology.

—— Éclaircissement sur une question d'Orthographie. Ib. 1861. (Ext. pp. 8.) Upon the initial of specific names.

—— Autonomie réelle du genre *Schufia*, détaché par M. Spach du genre *Fuchsia*. Ibid. 1862. (Ext. pp. 14.)

—— Quelques notes a l'occasion d'une publication récente de M. Dom. Clos. Ib. (Ext. 9 pp.) On the galls of *Pistacia*, Peloria of *Linaria origanifolia* and *L. alpina*, the habitat of *Pteris aquilina*, &c.

—— Sur une propriété singulière des vrilles de la Vigne-vierge (*Ampelopsis 5-folia*). Ib. (Ext. 9 pp.) Upon the mode of attachment of the tendrils.

—— *v.* Durand.

Dickie, G.—Brief Summary of a Report on the Flora of the North of Ireland. Brit. Ass. Rep. 1861, p. 240. Applying to the part of Ireland north of a line drawn W. from Dundalk. The phanerogamia are estimated at 725. The Flora is characterized by a large admixture of species of English and Scottish types, with a 'fair proportion' of the Atlantic type. Highland species are few.

Dippel.—Zur Histologie der Coniferen. Bot. Z. 1862. With 1 plate. On the structure of the medullary sheath, which corresponds essentially to that generally characteristic of Dicotyledons.

Döll, J. C.—Flora des Grossherzogthums Baden. Carlsruhe, 1862, Vol. iii. Completing the work.

Dronke, Dr.—Abnorme Fruchtbildung bei *Prunus Armeniaca*. Bot. Zeit. 1862, p. 350. An arrested branch, springing from a leafless, undivided stem.

Duchartre, P.—Recherches expérimentales sur les rapports des plantes avec la Rosée et les Brouillards. A. Sc. N. iv. ser. xv. p. 109. The chief part of this paper refers to experiments upon the relation of vegetation to dew. After indicating the sources of error in the experiments of Hales upon the subject, M. Duchartre proceeds to describe the apparatus employed and the method pursued in his experiments, a detailed account of which is given. It is shewn that leaves do not absorb the moisture condensed upon them, and that faded plants do not resume their turgescence by the direct action of dew. The deposit of dew, moreover, entirely, or almost entirely, prevents the loss of aqueous vapour by transpiration.

DUCHARTRE, P.—Sur la découverte du *Cymodocea aequorea* sur les Côtes de Provence. Bull. Soc. Bot. vii. p. 888.

——— Note sur deux Orchidées. Bull. Soc. Bot. ix. p. 30. These are *Angraecum sesquipedale* and *Oncidium splendidum*, A. Rich. The latter species, previously unpublished, is here described.

——— Sur le polymorphisme de la fleur chez quelques Orchidées. Ibid. p. 113. Written prior to the author's receipt of Mr. Darwin's paper on *Catasetum*, the dimorphism in which genus (also in *Cycnoches*) appears totally misapprehended. "En effet, celles-ci étant accidentelles, rares meme, rentrent simplement dans le catégorie de ces jeux de la nature qui échappent à toute règle et se refusent à toute explication!" The occurrence of two forms of perianth in *Vanda Lowei* is described: this he suggests may be a similar case of "dissociation" to that offered by *Cytisus Adami*. The two forms of fruit of *Ceratocapnos umbrosa* are minutely described. This genus is reduced to *Corydalis* by Hooker and Bentham.

——— Note sur un cas remarquable de gélivure. Ibid. p. 289. A case of *Populus angulata*, enclosing decayed central cones of wood, which it is surmised are due to the vitality of the alburnum having been destroyed while the bark retained the power of reproducing ligneous layers, thus prolonging the existence of the trees some 60 years.

——— Sur un cas de grossissement, sans Fécondation, des ovules du *Cycas revoluta*. Ibid. p. 531. The pollen of a *Ceratozamia* was placed upon the ovules: some of these enlarged to well developed fruits without containing any trace of an embryo. How far may this enlargement of the fruit be due to the influence of the foreign pollen?

——— Sur la Florasion du *Vanda Batemanni*. Rapp. Journ. Soc. d'Hort. viii. p. 589.

DURAND, E.—Monographie Vites Boreali-Americanae.—Act. Bordeaux, 1862, (Ext. with Introduction by M. Desmoulins, pp. 64.)

DUVAL-JOUVE, J.—Note sur un *Catabrosa aquatica* a épillets multiflores et sur le genre *Catabrosa*. Bull. Soc. Bot. ix. p. 8. The *Catabrosa* occurred with from 3- to 7-flowered spikelets. Observations are added on the distinctions usually cited between this genus and *Glyceria* which are based upon variable characters.

——— Note sur le *Catabrosa aquatica* a épillets uniflores. Ibid. p. 437.

——— Note sur le Synonymie du *Poa palustris*. Ibid. p. 453.

——— Sur une Forme naine de *l'Aira media*. Ibid. p. 527. Followed by observations of M. Gay's.

EBENHÖCH, Fr.—Die Phanerogamen Pflanzen von Koronczó und dessen Umgebung. Presb. Verh. v. p. 45.

Edgeworth, M. P.—Florula Mallica. Linn. Proc. Bot. vi. p. 179. with 1 Pl. An enumeration of the plants (exclusive of Fungi) of the Multan division of the Punjab, "where the Malli resided in the time of Alexander." But 338 species, exclusive of cellular plants, are named. These belong to 67 orders, and 226 genera; thus averaging 1·5 to each genus.

Eichler, A. W.—Flora Brasiliensis, Fasc. 31. Dilleniaceae. With 13 plates. No new genera are described. Observations are appended on the anatomy of the stem.

——— Ueber die Bedeutung der Schuppen an den Fruchtzapfen der Araucarien. Flora, 1862, p. 369, with 2 plates. *Apropos* of an abnormal cone of *Araucaria brasiliana* the composition of the ovule-bearing scales is discussed. In *Araucaria* these are regarded as consisting of a closed carpel, from the central region or midrib of which an inverted orthotropous ovule is developed, having its integument free from the nucleus, excepting at the chalaza.

Engelmann, Dr.—Revision of the *Oenotherae* of the subsection *Onagra*. Am. Journ. ser. ii. xxxiv. p. 332.

——— vide *Parry*.

Evercken, E.—Beiträge zur Westfälischen Phanerogamen-Flora. Rheinl. Verhandl. xix Jahrg. p. 212.

Fée, A.—Sur le Ligustrum des Latins et sur la difficulté de rattacher la nomenclature botanique des anciens à la notre. Bull. Soc. Bot. ix. 205.

Finckh, R. — Beiträge zur Württembergischer Flora. Württ. Jahresh. xviii. p. 189.

Fischer, L.—Verzeichniss der Phanerogamen und Gefässkryptogamen des Berner-Oberlandes und der Umgebung von Thun. Berne, 8vo. pp. 128, 1862. A guide for the use of botanical tourists, &c.

Fleischer, Prof.—Ueber Missbildungen verschiedener Culturpflanzen und einiger anderen landwirthschaftlichen Gewächse. Esslingen, 1862, pp. 100, 8vo. with 8 plates. 1. Monstrosity of the flower and fruit of *Brassica Napus*, var. *oleifera*, Koch; 2. of *Carum Carui;* 3. *Dipsacus Fullonum;* 4. *Trifolium hybridum* and *T. repens;* 4. *Poterium polygamum;* 5. *Colchicum autumnale;* 6. Fasciated stem of Beet and other plants; monstrous leaves of *Morus alba*.

Foote, F. J.—On the Distribution of Plants in Burren, County of Clare. Trans. Irish Acad. xxiv. p. 143, with map. Lists are given of (1) plants abundantly and tolerably equally distributed over the whole district of "the Burren" (the rocky limestone hills of the N.W. corner of Clare); (2) plants confined to a portion of the district, and abundantly distributed throughout that portion; (3) plants growing locally, but in colonies; and (4) occurring locally. In each list the characteristic or more remarkable species are italicised. *Pyrola media* is included in the second and *Ajuga pyramidalis* in the third list. A "double" *Orchis* *pyramidalis* is said to occur on the shore near Ballyvaughan. Grasses and Carices are passed over by the author.

FOURNIER, E. and M. BONNET.—Sur une Monstruosité de *Rubus*. Bull. Soc. Bot. ix. p. 36, with 1 plate. In this monster the calyces were hypertrophied and succulent, the petals smaller than usual, green, and imperfectly developed. There was no trace of stamens, and the carpels were borne on an elevated torus, and were pedicellate, concave towards the axis, glabrous and dry, terminated by a style about as long as the fruit; thus presenting some of the characters of *Geum*.

FOURNIER, E.—Note sur le *Triglochin laxiflorum*, Guss. Bull. Soc. Bot. ix. p. 204. Re-establishing the species in the Corsican Flora.

——— Sur la végétation des Environs de la Calle (Algérie). Ibid. p. 422. With a catalogue of species gathered by M. Lefranc and determined by Cosson, and descriptions of two new species.

——— De la Classification adoptée par MM. Bentham et Hooker, pour les genres de la Famille des Crucifères. Ibid. p. 449.

——— Sur l'embryon du genre *Stroganowia*. Ibid. p. 535. Illustrating the variability of embryonal character in Cruciferae.

FRIES, E.—Epicrisis Generis Hieraciorum. Upsalia. 1862, pp. 158. 8vo.

FRIES, T. M.—Anteckningar rörande en i Paris befintlig Linneansk växtsamling. Stockholm Förhandl. 1861, p. 255.

GANSAUGE, von.—Ueber *Taxus baccata*. Bot. Zeit. 1862, p. 94. On the occurrence of the Yew in North Germany.

GARREAU, L.—On the Functions of the Nitrogenous matter of Plants. A. N. H. 3rd ser. x. p. 33.

GAY, J.—Note sur l'*Erucastrum Zanonii*. Bull. Soc. Bot. vii. p. 878.

——— Excursion botanique en Auvergne. Bull. Soc. Bot. ix. pp. 18, 78, 102. Including observations upon *Isöetes*.

——— Sur la patrie de l'*Ajax muticus*. Bull. Soc. Bot. ix. p. 279.

GERMAIN DE ST. PIERRE.—Phénomène de l'expansivité dans les axes et dans les feuilles, observé sur un même rameau d'Olivier. Caractères qui distinguent les rameaux d'une partition des rameaux normaux nés sur une tige fasciée. Bull. Soc. Bot. vii. p. 584. The author endeavours to show that the phenomenon of '*chorisis*' or '*dédoublement*,' is simply a fasciation of high degree, or 'in its most complete expression.' A case of lateral *dédoublement* of a branch of *Olea europæa* is described, in which the axis was divided into several nearly parallel (not as in normal branches from leaf-axils, divergent) flattened branches, bearing bifid or bipartite leaves, from the axils of which normal branches originated.

GERMAIN DE ST. PIERRE.—Caractères des feuilles anomales frondipares. Feuille frondipare chez le Murier. Ibid. p. 586. An instance of parallel 'dédoublement' in the leaf of the mulberry.

——— Structure et mode de développement de la souche bulbiforme du *Corydalis solida*. Ibid. p. 590. A reply to M. Michalet's observations on the same. (t. vi. pp. 779, 804.)

Germain de St. Pierre.—Anomalies de la racine bulbiforme du *Corydalis solida*, et production exceptionnelle analogue chez un *Daucus Carota*. Ibid. p. 594.

——— De la production et de la délimitation des espèces végétales. Ibid. p. 691.

Gernet, C. v.—Xylologische Studien. Mosc. Bull. 1861, Vol. 34, p. 423. With 1 plate. 1. On the Stem-structure of *Thalictrum flavum*. 2. On Balta-wood: Description of a specimen, thus named, from Patagonia.

Gieswald, H.—Ueber den Hemmungsprozess in der Antherenbildung. Danzig. 4to. pp. 35. With 1 plate. (*Vide* Bot. Z. 1862, p. 111). The results of the author's investigation of imperfectly developed stamens or structures intermediate between petals and stamens, refer chiefly to the differentiation of tissues in the anther, the development of pollen-cells, the resorption of the wall of the mother-cells, and of the septa of the anther-cells.

Gibson, G. S.—The Flora of Essex; or a List of the Flowering Plants and Ferns found in the County of Essex, &c. 1862. With 4 plates and map. Tables are given (1) of the distribution of Essex plants in the eight Botanical districts into which the County is divided; (2) of the earliest and latest dates at which the rarer species have been observed; (3) of the comparative abundance of species in the County; (4) a comparison of the Essex Flora with those of Cambridgeshire, Hertfordshire, Suffolk and Kent, also (5) with the sub-provincial distribution of 'Cybele Britannica;' (6) of species likely to be found in Essex. Short biographical notices are appended of botanists who have worked on the Essex Flora, including Ray and Forster. (*vide* N. H. R. 1863, p. 41).

Gillet.—Nouvelle Flore Française. Paris. 1 vol. 8vo. pp. 620.

Glehn, P. v.—Flora der Umgebung Dorpat's. Arch. Nat. Kurlands, &c. Bot. ii. p. 489.

Goeppert, H. R.—Ueber das Verhalten einer *Mimosa pudica* während des Fahrens. B. Zeit. 1862, p. 110. Referring to the influence of continued irritation upon the sensibility of the plant.

——— Geräusch beim Durchschneiden eines Cycadeen-zapfens, Bonpl. 1862, p. 59. Attention is directed to the report made by the rupture of the spathe of certain Palms. A similar phenomenon was observed in cutting a female cone of *Zamia* transversely.

Gras, A.—Sur la Synonyme d'une espèce de *Ranunculus*. Bull. Soc. Bot. ix. 324. *R. Philonotis*, Ehrh. is the species in question.

Gray, A.—Enumeration of Plants collected in the Rocky Mountain Range, 1861. Am. Journ. Sc. 1862, xxxiii. pp. 8, 404, xxxiv. p. 249. With Supplement by Engelmann and Gray.

——— Revision of the genus *Castilleia*. Ibid. p. 335.

——— Review of the genus *Mertensia*. Ibid. p. 339.

——— Fertilization of Orchids through the Agency of Insects. Ibid. p. 420. Notes upon some American species. In *Platan-*

thera psycodes and *P. lacera* the nectar appears to be much more plentiful in the spurs of the older flowers from which the pollinia have been removed and the stigmas fertilized several days before than in newly-opened blossoms. In the latter, however, the spurs are already moistened with nectar. The pollen of *Gymnadenia tridentata,* falling upon the tip of the process of the rostellum which rises between the discs and upon the summit of the process outside each disc, is stated to adhere and to send down tubes freely into their substance. The normal stigma is in its proper place, underneath the discs. In none of the N. American species of *Cypripedium* is the pollen found so glutinous as in the species examined by Mr. Darwin. Dr. Gray believes them to be fertilized by insects "which crawl bodily into the flower," entering by the front entrance they crawl under the face of the stigma, while feeding on the glutinous exudation of the beard lining the labellum their heads or backs are rubbed against the stigma, then passing on they find exit by one of the lateral openings, carrying off a charge of pollen as they escape. The stigma in *C. spectabile* and other species is not glutinous but beset with rigid papillae directed forwards, adapted to "card off" the pollen carried by insects feeding beneath it.

——— Notes upon the "Descriptions of New Plants from Texas, by S. B. Buckley," published in the Proc. Acad. Nat. Sciences of Philadelphia. Proc. Ac. Phil. 1862, p. 161. Dr. Gray shows that all the new genera and nearly all the new species described by this author are "either oversights or mistakes." They are critically noticed seriatim.

——— Notes upon a portion of Dr. Seemann's recent collection of Dried Plants gathered in the Feejee Islands. Proc. Am. Ac. v. p. 314. Also in Bonplandia. 1862, p. 34. With a description of the genus *Couthovia,* Gray, near *Strychnos.*

——— Characters of New or Obscure Species of Plants of Monopetalous Orders in the Collection of the United States South Pacific Exploring Expedition, under Captain Wilkes. Ibid. p. 321. vi. p. 37. *Nothocestrum,* a new genus is described. The generic character of *Nesogenes* is amended and completed.

——— Additional Note on the genus *Rhytidandra.* Ibid. p. 55. With description of fruit and seeds.

——— Synopsis of the genus *Pentstemon.* Ibid. p. 56.

——— Revision of the North American Species of the genus *Calamagrostis,* Sect. *Deyeuxia.* Ibid. p. 77.

——— Sur la graine du *Magnolia* (réclamation). A. S. N. ser. iv. pp. 17, 382.

Gris, A.—Note sur les Téguments de la graine du ricin. A. Sc. Nat. ser. iv. xvii. p. 312. Referring to the origin of the integuments of the seed. M. Gris confirms his previously published opinion, in opposition to that of M. Planchon, "that the primine is formed of parenchyma, protected on both sides by a thin

layer of epidermal cells," and, "that the secundine is clothed upon its outer surface with a broad zone of much elongated, very narrow cells, which are inflected to line the mouth of the endostome." M. Planchon adds a note, admitting his probable error.

Gris, A.— Origine des canaux périspermiques dans le *Thalia dealbata.* Bull. Soc. Bot. vii. p. 875.

——— Note sur le Fécule du Riz. l. c. p. 876.

——— Note sur le Système Tégumentaire de la graine du ricin. Bull. Soc. Bot. ix. p. 433.

——— Note sur le développement de l'Aleurone dans les graines de quelques Légumineuses. Ibid. p. 466. Describing the mode of development of the aleuron-granules in the cotyledons of *Lupinus polyphyllus* and *Colutea arborescens.* M. Gris' account is at variance with that given by both Hartig and Trécul.

Grisebach, A. H. R.—Notes on *Coutoubea volubilis*, Mart., and some other Gentianeæ of Tropical America. Linn. Proc. Bot. vi. p. 140. A plant believed to be of this species, sent home by Wright from Cuba, Prof. Grisebach finds generically new, and describes it under the name of *Goeppertia.* Upon another species of the same collection, connecting *Lisianthus* and *Leianthus*, is based the new genus *Zonanthus.*

——— Notice sur le genre *Rheedia.* A. S. N. ser. iv. xv. p. 231. A reply to a criticism of Messrs. Planchon and Triana in their monograph of the Guttiferae.

Gubler, A.—Fasciation du *Cytisus Laburnum*, avec inflorescence acrogène et floraison automnale. Bull. Soc. Bot. vii. p. 870.

——— Sur un hybride des *Primula officinalis* et *elatior.* l. c. p. 872.

——— Des anomales aberrantes et régularisantes à propos de deux cas tératologiques, l'un de géantisme et l'autre d'hermaphroditisme, observés sur le *Pistacia Lentiscus.* Bull. Soc. Bot. ix. p. 81. With notice of an hermaphrodite *Lentiscus.*

——— Préface d'une Réforme des espèces fondée sur le principe de la variabilité restreinte des types organiques, en rapport avec leur faculté d'adaptation aux milieux. Ibid. pp. 194, 264, 370.

——— *L'Helichrysum arenarium* au Bois de Boulogne. Ibid. p. 344.

——— Quelques mots sur la Distribution Géographique de *l'Helichrysum arenarium.* Ibid. p. 507.

Gulliver, G.—On the Fibrin and Latex of Vegetables, and on the Coagulation of Fibrin without evolution of Ammonia. A. N. H. ser. iii. ix. p. 192. Showing that the coagulation of latex is due to fibrin. Attention is directed to the rapidity with which the latex is coagulated on the addition of water; in this respect remarkably differing from the *liquor sanguinis.*

Hallier, E.—Vorschlag zu einer neuen Bezeichnung der Vegetationsperioden. Bonpl. 1862, p. 50. Proposing signs to denote simple and compound periods of vegetation, with the duration of each respectively, etc.

HANCE, H. F.—Symbolae ad Floram Sinicam adjectis paucissimarum stirpium japonicarum diagnosibus. A. S. N. ser. iv. xv. p. 220. No new genera are described. A short list of Hongkong species, not included in Mr. Bentham's Flora, is added.

HARTIG, T.—Ueber die Bewegung des Saftes in den Holzpflanzen. Bot. Zeit. 1862, p. 73 (continued, with interruptions, to p. 105). Embracing the following heads:—1. Experiments on Defoliation of the Weymouth Pine. Chiefly to ascertain the influence of the foliage on the amount and relative position of the deposit of wood, and also the extent to which the reserve materials stored in the tree cooperated in the formation of the wood. 2. Experiments on ringing pendant branches. The results the same as upon erect stems. 3. Result of pressure in a spiral direction upon the bast-layer of the Weymouth Pine. 4. Ringing experiments on the Black Pine. 5. Experiments with cuttings. 6. Does the bast-layer take part in the ascent of the sap? 7. On the 'Tears' of woody plants—the dew-like drops observed on the buds, etc. of various trees in spring. 8. The 'Bleeding' of the Oak; and, 9, of the Walnut. 10. On the loss of the power to conduct sap by long exposed, wounded surfaces of trees. 11. On the movement of the Ptychode-sap. (The protoplasm circulating between the outer and inner Ptychode-membranes: the outer Ptychode of Hartig is the Primordial utricle of v. Mohl). 12. On the motion of the sap in the 'laticiferous' tissue.

HARVEY, W. H. and W. SONDER.—Flora Capensis. Vol. ii. Leguminosæ to Loranthaceæ. 1862. The new genera described are—*Walpersia*, *Pleiospora*, and *Xerocladia*, Harv. (Leguminosæ); *Dinacria*, Harv. (Crassulaceæ); *Pisosperma*, Sond. (Cucurbitaceæ); *Rhyticarpus*, *Glia* and *Pappea*, Sond. (Umbelliferæ).

HASSKARL, J. K.—Nachträge und Verbesserungen zu Horti Malabarici clavis nova. Flora, 1862, pp. 41, 73, 121, 153, 187.

HELDREICH, T. VON.—Die Nutzpflanzen Griechenlands: mit besonderer Berücksichtigung der neugriechischen und pelasgischen Vulgarnamen. Athen. 1862, 8vo. pp. 103. Besides the enumeration of economic species, with their modern Greek and Albanian vulgar names, observations are added upon their culture and application when worth notice. An Appendix is devoted to wild esculent herbs—the so-called *λάχανα*.

HÉTET, M.—Recherches expérimentales d'organogénie et de physiologie végétales. C. Rend. liii. p. 1004. Upon the reproduction of vascular tissue upon a decorticated surface of *Pircunia dioica*, Moq.

——— Recherches expérimentales sur la formation des couches ligneuses dans le *Pircunia*. A. S. N. ser. iv. xvi. p. 218. In *Pircunia* the growth of the wood is very rapid, several layers being formed each year. Hence it suggested itself as suited for the author's experiments, instituted in order to find out how far the zones of cellular tissue deeper than the cambium layer,

and, indeed, the innermost of these, retained the power of reproducing tissue when mutilated. It was found that the deepest parenchymatous zones and even the medullary canal could reproduce woody bundles and a cortical tissue, and that wherever the cells were yet active, or retained sufficient vitality, vessels and fibrous fascicles were formed.

HÉTET, M.—Liste des Plantes qui ont résisté en plein air, depuis plusieurs années, au Jardin botaniques de la Marine à Brest. Ibid. p. 379.

HEUFFEL, J.—Fragmenta Monographiae Caricum in regnis Hungariae, Croatiae, etc. sponte nascentium. Linnaea, xxxi. p. 659. With 2 plates.

HILDEBRAND, F.—Ueber einige Fälle abnormer Blüthenbildung. Bot. Z. 1862, p. 209. With a plate. 1. Monstrous flowers of *Convallaria majalis*. 2. *Peloria* of *Viola odorata*. 3. Abnormal flowers of *Sarothamnus scoparius*.

HINCKS, W.—Specimen of a Flora of Canada. Canad. Journ. 1861, p. 276.

HOFFMANN, H.—Ein Versuch zur Bestimmung des Werthes von Species und Varietät. Bot. Zeit. 1862, p. 1. The author's observations refer chiefly to colour, markings, etc. of the seeds of *Phaseolus vulgaris*.

HOFMEISTER, W.—Ueber Spannung, Ausflussmenge und Ausflussgeschwindigkeit von Säften lebender Pflanzen. Flora, 1862, p. 97. (continued to p. 175). With supplementary tables of measurements (1) of the quantity of sap flowing from a stem cut across immediately above the root, in *Urtica*, *Solanum nigrum*, *Helianthus*, and other plants: (2) of the pressure of the sap under like conditions in herbaceous plants: and (3) of the same from cut branches and roots of the Vine. M. Hofmeister concludes that the bleeding depends upon the pressure which the tension of the cell-walls of the parenchym and the endosmotic repletion of the cells exercise upon the tissues of the root generally, whereby a portion of absorbed fluid is forced into the vessels.

——— Ueber die Mechanik der Reizbewegungen von Pflanzentheilen. Ibid. pp. 497, 513.

——— Sur les directions des parties végétaux determinées par la pesanteur. A. Sc. Nat. IVe. ser. xv. p. 179. 1. Differences in the tension of tissues. 2. Elongation of the curving parts during incurvation. 3. Mechanism of upward curvature. 4. Intensity and independence of upward, and the dependence of downward, curvature. 5. Equality in the tension of tissues in those parts of the root capable of downward curvature. 6. Mechanism of the geocentric curvature of roots. 7. Deviations from the vertical direction of stems. 8. Experiments on rotation.

HOLLE, G. v.—Flora von Hannover. Hft. 1. Ferns to Amentaceae. Hannover, 1862.

Hooker, J. D.—Des Phénomènes généraux de la Variation dans le Règne Végétal. A. S. N. ser. iv. xvi. p. 97. An extract from the Introductory Essay to the Tasmanian Flora.

——— (*vide* Bentham.)

——— On *Welwitschia*, a new genus of Gnetaceae. Linn. Trans. xxiv. p. 1. (*vide* N. H. R. 1863, p. 201.)

Hooker, W. J.—Botanical Magazine. Vol. 1862. Including descriptions of *Acanthonema*, a new genus of *Cyrtandraceae* from Fernando Po, and *Berberidopsis* (Berberideae) from Chili.

Horaninow, P.—Prodromus Monographiae Scitaminearum. Petrop. 1862, pp. 45, fol. Four plates. *Achirida*, based on *Canna iridiflora*, R. et P.; *Dymczewiczia*, on species of *Zingiber*, including *Z. capitatum* and *Z. elatum; Nicolaia*, on some *Alpinias; Geocallis*, on *Renealmia fasciculata*, Rosc.; and *Ensete*, on *Musa Ensete*, are the new genera proposed.

Irmisch, Th.—Kleinere Original-Mittheilung: Notiz über die Rubus-Arten. Bot. Z. 1862, p. 295.

Jäger, G. v.—Beobachtungen über rankende Gewächse, namentlich über Epheu (*Hedera Helix*). Württ. Jahresb. 1862, p. 62.

Jordan, A.—Quelques mots sur le *Geranium purpureum*, Vill., suivies de la description de deux plantes nouvelles des environs de Grenoble. Bull. Soc. Bot. vii. p. 605.

——— Sur diverses espèces négligées du genre *Asphodelus*, comprises dans le type de l'*Asphodelus ramosus* de Linné. Ibid. p. 722. Appended are detailed descriptions of 17 'species' of Asphodel.

Jolis, A. le—De l'influence chemique des terrains sur la dispersion des plantes. Mem. Soc. Cherb. viii. p. 309. M. le Jolis is of opinion that the influence of soils in the distribution of plants is primarily chemical; the physical influence he regards as secondary 'et pour ainsi dire consécutive': its physical state being a consequence of its chemical composition.

——— Sur une Forme du *Cochlearia danica*. Bull. Soc. Bot. ix. p. 421. The stem-leaves are usually sessile in this variety.

Jullien-Crosnier, A.—Catalogue Systématique de quelques plantes nouvelles pour la flore orléanaise. Extr. Mém. Soc. Maine-et-Loire, xii.

Kabsch, W.—Ueber die Einwirkung verschiedener Gase und der luftverdünnten Raumes auf die Bewegungserscheinungen im Pflanzenreiche. Bot. Zeit. 1862, p. 341, 353. The author's experiments are detailed upon various sensitive and sleeping plants exposed to different gases, under reduced atmospheric pressure, and subjected to an electrical current.

Kanitz, A.—Botanische Notizen. Bot. Z. 1862, p. 190. On *Urtica galeopsifolia* and *Aethionema banaticum*.

——— Eine Excursion auf dem Domogled. Bonpl. 1862, p. 152. With the plants observed.

——— Geschichte der Botanik in Ungarn. Ibid. p. 310. From Winterl to Haberle.

KARSTEN, H.—Florae Columbiae terrarumque adjacentium specimina selecta. v. ii. fasc. 1. New genera described are *Paryphosphæra* (Parkieae, a well-known species of *Parkia*), *Mallostoma* (Cinchonaceae), *Androphoranthus* (Crotoneae, described in Koch's Wochenschr. 1859, p. 1), *Olmediopsis* (Olmedieae), *Rhetinophloeum* (Caesalpinieae).

——— Histologische Untersuchungen. With 3 plates. Berlin, 1862. The development and structure of the vegetable cell, illustrated chiefly by a detailed study of certain fresh-water Algae. The chapters referring principally to Phanerogamia are the 1st.—on cork-cells, their origin, resorption, &c.; and 7th.—on the Development of Pollen and of the spinous processes upon the surface of some of its granules. In the 11th are observations on Intercellular Substance, Cuticle, the Primordial utricle, &c.

——— Ueber *Zizania aquatica*, L. Linnaea, xx. p. 510.

KIRSCHLEGER, FR.—Flore d'Alsace et des contrées limitrophes. Strasbourg, 1858-62. 12mo. pp. 456.

——— Sur les plantes des vieux Chateaux, dans la région Alsato-vosgienne. Bull. Soc. Bot. ix. 15. Supplementing M. Chatin's paper noticed previously.

——— Note sur les Rubus monstrueux. Ibid. p. 290.

——— A quelle époque remonte l'établissement du premier herbier? p. 202. Traced back to the time of John Falconer and Luca Ghini, 1541, &c.

KLATT, F. W.—Monographia generis *Sisyrinchium*. Linnaea, xv. p. 63. The detailed descriptions are preceded by a tabular synopsis. 42 species are enumerated. Nachtrag. p. 244. Berichtigungen, &c. p. 371.

——— Monographie der Gattung *Libertia*. Ibid. p. 380. With descriptions of 7 species.

—— Specimen e familia Iridearum. Ibid. 533. With new or amended descriptions of many species.

KLINGGRÄFF, H. v.—Die in d. Umgegend von Agram in Croatien vorkommenden Pflanzen. Linnæa, xv. 6. In anderen Gegenden Croatiens gefundene Pflanzen, p. 49.

KLINGGRÄFF, C. J. v.—Ueber die Verbreitung einiger Holzpflanzen in der Provinz Preussen. Königsb. Schrift. 1861, p. 119.

KLOTZSCH, FR. und A. GARCKE.—Die botanischen Ergebnisse der Reise seiner K. H. des Prinzen Waldemar von Preussen in den Jahren 1845-6. Berlin, 1862. 1 vol. 4to. pp. 164, tabb. 100. Seven new genera are described, none of which appear to be tenable. They are *Stachyopogon* (= *Aletris*), *Hersilea* (= *Aster*), *Leptanthe* (= *Macrotomia*, A. D. C.), *Waldemaria* (= *Rhododendron argenteum, &c.*), *Lepidopelma* (= *Sarcococca*), *Timæosia* (= *Gypsophila*), *Carpophora* (= *Silene*). (*vide* N. H. R. 1863, p. 378.)

KNAPP, F.—Ueber eine neue Form der *Pulmonaria*. Flora, 1862. With a diagnosis of the new Thuringian species, *P. parviflora*.

Koch, G. F.—Beiträge zur Flora der Pfalz. Pollichia, xviii-xix. 38.

Landerer, Dr.—Ueber die Gartenkultur in Griechenland. Flora, 1862, p. 11.

Sachs, J.—Zu Nägeli's Abhandlung "Ueber die Wirkung des Frostes auf die Pflanzenzellen." Flora, 1862, 17.

——— Zusammenstellung der in Griechenland sich findenden Fruchtbäume. Bonpl. 1862, p. 149. Die in Griechenland und im Oriente angebauten Getreidesorten, p. 176.

Lange, M. T.—Tillaeg til Denmarks Flora. Vid. Medd. Kjöb, 1861, p. 1.

——— Pugillus plantarum imprimis hispanicarum quas in itinere, 1851-52, legit J. Lange. Ibid. p. 33.

Lawes, J. B. and J. H. Gilbert.—Growth of Wheat by different Manures, several years in succession on the same land. Journal Agric. Soc. xlix. p. 31.

Lebel, E.—Sur le *Primula variabilis.* Bull. Soc. Bot. ix. p. 438.

Lecoq, H.—De la Fécondation naturelle et artificielle des végétaux et de l'Hybridation considérée dans ses Rapports avec l'Horticulture, &c. Vol. 2. Paris, 1862. The chapters are headed, 1. Natural Fertilisation. Various modes of fertilisation observed in Plants. 2. The Species and its varieties. 3. Artificial Fertilisation: Hybridization and means of effecting it. In subsequent chapters the Natural Orders are treated seriatim with regard to species capable of being crossed or upon which desirable experiments should be tried.

——— De la fécondation indirecte dans les végétaux. Bull. Soc. Bot. ix. p. 211, and C. Rend. liv. p. 1247. Fertilisation of a pistil by the pollen of its own flower, M. Lecoq terms 'fécondation directe;' by the pollen of another flower, 'fécondation indirecte.' The former he believes to be the exception and not the rule. The chief conditions under which hermaphrodites become incapable of self-fertilisation are enumerated, also a series of grades intermediate between truly hermaphrodite and unisexual flowers. No original experiments are given.

——— De l'espèce et de ses croisements dans le genre *Mirabilis.* Bull. Soc. Bot. ix. p. 217. In *Mirabilis* hybrids between species were found to be exactly intermediate. Hybrids, however, between hybrids become, on the other hand, infinitely varied, sometimes differing much from their types. Fertile seeds were afforded in small quantity by the hybrid plants.

——— Botanique populaire. Paris, 1862. 8vo. pp. 408.

Lehmann, E.—Beitrag zur Kenntniss der Flora Kurlands. Arch. Nat. Kurlands. i. p. 539.

Lemaire, Ch.—Histoire et Révision du genre *Pilocereus.* Rev. Hort. 1862, p. 426.

Letzerich, L.—Ueber die Befruchtung und Entwickelungsgeschichte des Embryon von *Agrimonia Eupatoria.* Bot. Zeit. 1862, p. 9. With figs.

Liebe.—Ueber die geographische Verbreitung der Schmarotzerpflanzen; 1ste Abth. Loranthaceae, *Cuscuta*, *Cassytha*, and Rhizantheae. Berlin. 4to. 1862, pp. 24.

Lindley, J.—Description of *Otacanthus*, a new genus of Acanthaceae from Brasil. Fl. des Serres, 1862, tab. 1526.

——— West African Tropical Orchids. Linn. Proc. Bot. vi. p. 123. Chiefly an enumeration, with descriptions of new species, of the Orchids collected by Barter and Mann. Of the 67 species examined 48 were previously undescribed. But little resemblance is traced with Abyssinian species; only one species of *Eulophia* being common to W. Africa and Abyssinia.

Löhr, M. J.—Ueber das Einschliessen jeder Pflanzen-species in eine Papier-hülse als Mittel, um Herbarien gegen Insekten zu sichern. Rheinl. Verhandl. xix. Jahrg. p. 335.

Loret, H.—L'Herbier de la Lozère et M. Prost. Bull. Soc. Sc. Mende, 1862. Critical determinations of an herbarium formed in the Lozère by M. Prost, and preserved in the Museum at Mende.

Lowe, R. T.—A Manual Flora of Madeira and the adjacent islands of Porto Santo and the Dezertas. Pt. 2. London, 1862. *Calyciflorae :* Celastraceae to Rosaceae.

Luca, S. de.—Ricerche sulla formazione della materia grassa nei frutti dell' Olivo. Soc. R. Nap. 1862, p. 33.

——— Recherches sur la Formation de la matière grasse dans les Olives. A. Sc. N. ser. xv. p. 92.

——— Recherches chimiques sur les éléments minéraux contenus dans quelques plantes épiphytes du Jardin des Plantes, &c. C. Rend. liii. p. 244. The ash of all the plants subjected to analysis included potash, soda, lime, magnesia, alumina, silica, iron, manganese, chlorine, sulphuric and phosphoric acids. In some copper was found.

Malbranche, M.—Revue des plantes critiques ou nouvelles de la Seine Inférieure. Extr. Précis, Ac. Sc. Rouen, 1861-2.

Malmgren, J.—Öfversigt af Spetsbergens Fanerogam-Flora. K. Vet.-Ak. Förh. 1862, p. 229. Ninety-three phanerogamic Spitzbergen species are enumerated, of which fifteen are new to Dr. Hooker's list (Linn. Trans. xxiii. p. 283, where the Spitzbergen species are indicated by S. in the column 'Arctic Europe'). On the other hand Dr. H. has eight or nine not in Hr. Malmgren's enumeration. Spitzbergen is said to be richer in species, considering its latitude, than any other Arctic tract. This is attributable, to the influence of the Gulf-stream. Of the 93 species 81 are common to Greenland. It is remarkable, however, that none of the species common to these Floras are absent from the Arctic Flora of the mainland of the Old World. Hr. Malmgren says the Flora of the Northern Coast of Spitzbergen, under 80° lat. differs considerably from that of the Western, and approaches in character to that of Lancaster Sound, Barrow's Straits and

Melville Sound. The Flora of the W. Coast has a more decidedly N. European character. The absence of Leguminosæ (in common with Arctic Greenland and Iceland) is very remarkable, as is also the paucity of Monopetalous (Corollifloral) plants.

MANGON, H.—Production de la matière verte des feuilles sous l'influence de la lumière électrique. C. Rend. liii. p. 243. On the development of chlorophyll in Rye under the influence of electric light.

MARTENS, G. VON.—Die Farben der Pflanzen. With a chromatic table. Württ. Jahresh. xviii. p. 239.

MARTINS, C.—Floraison de l'*Agave americana*. Rev. Hort. 1862, p. 291.

——— Sur la floraison simultanée de 1500 *Agave americana* dans les plaines de Mustapha près Alger. Bull. Soc. Bot. ix. p. 146. These Agaves, which had been encouraged by the Arabs as a coast defence, were mutilated by the French soldiers during the winter 1831-2; in the spring of the latter year all the maltreated plants threw up their flowering axes, confirming the theoretical views of Linnaeus and Goethe, that the development of the inflorescence is determined by some debilitating check of the vegetative activity of the plant. M. Martins has instituted experiments upon the subject.

MARTIUS, C. F. PH. DE.—Flora Brasiliensis. *Vide Eichler* et *Miquel.*

MARTRIN-DONOS, V. DE.—Plantes critiques du département du Tarn. Pt. 1. Toulouse. 1862. 8vo. pp. 32,

MASTERS, M. T.—Vegetable Morphology: its History and Present Condition. Brit. and For. Med. Review, *Jan.* 1862.

——— On Prolification in Flowers, and especially on that kind termed Axillary Prolification. Linn. Trans. xxiii. p. 481, 1 pl. "Axillary prolification is the term applied to those cases wherein one or more adventitious buds spring from the axils of one or more of the parts of the flower." The orders and genera in which it is most frequent are Cruciferae (*Brassica*), Caryophyllaceae (*Dianthus*), Resedaceae, Leguminosae (*Melilotus*, *Trifolium*), Rosaceae (*Rosa*, *Potentilla*), Umbelliferae and Campanulaceae. The largest number of cases occur in plants with the parts of their floral whorls not united. It is rarely met with in irregular gamopetalous flowers, and plants with an indefinite inflorescence are more liable to it than those in which it is definite.

Median prolification is much more frequent than axillary. The former "is a further step in retrograde metamorphosis" than the latter. "To grow in length, and to produce axillary buds, are alike attributes of the branch; but the former is much more frequently called into play than the latter; for the same reason, median prolification is more common than the axillary form." The flower of a *Daucus* is figured in which the calyx was tubular and 5-toothed: the carpels foliaceous, separate and without ovules; the axis being prolonged between them where it forked, each branch bearing an umbel of perfect flowers. The calyx and leafy carpels are minutely described. About 65 genera belonging to 29 Orders are enumerated, in which axillary prolification has been observed.

MAUGIN, G.—Sur quelques faits de Tératologie végétale.—Bull. Soc. vii. 867.—Trifoliation in *Syringa*, torsion and fasciation of *Sambucus*, etc.

——— Sur les mouvements du cone central de l' *Agave Americana*. Bull. Soc. Bot. ix. p. 360. With diagrams, shewing varying direction of the inclination of the cone.

MAXIMOWICZ, C.—*Golowninia*, un nouveau genre de la famille Gentianeae; avec une introduction de M. Regel. 1 Pl. Bull. Ac. Sc. St. Petersb. iv. 250. Regel proposes *Crawfurdieae*, characterized by twining stems, as a section of Gentianeae. Diagnoses are given of the 4 genera constituting this group,—viz. *Crawfurdia*, *Pterygocalyx*, *Tripterospermum*, and the new genus *Golowninia*, from Japan: of this latter a detailed description is given.

MÉLICOCQ, LE BARON DE.—Encore un mot sur le Climat de la France au moyen age. Bull. Soc. Bot. ix. 37.

METTENIUS, G.—Beiträge zur Anatomie der Cycadeen. K. S. Wiss. Leipzic. vii. 567, with 5 plates. 1 and 2. Course and structure of the bundles of the medullary sheath; 3. The wood; 4. The bark; and 5. The root.

MIALL, L. C. and B. CARRINGTON.—The Flora of the West Riding of Yorkshire. London. 8vo. pp. 97.

MICHALET, E.—Sur le végétation et la structure du *Lloydia serotina*. Bull. Soc. Bot. vii. 676. The structure and development of the bulbs and stolons is described.

——— Sur la végétation du Jura. Bull. Soc. Bot. vii. p. 703.

MIERS, J.—On *Villaresia*. A. N. H. ser. 3. ix. p. 107. With amended descriptions of the genus,—referred, with Jussieu, to Aquifoliaceæ,—and of new species.

——— On *Ætoxicum* and *Bursinopetalum*. Ibid. p. 214. Amended descriptions are given of the genera, which are both referred to Aquifoliaceæ.

——— On *Goupia*. Ibid. p. 289. A very minute account is given of the structure of the flower, fruit, and seed of the genus, which Mr. Miers makes the type of a Family—Goupiaceæ, included in his 'Celastral alliance' with Icacineae, Aquifoliaceae, Hippocrateaceae, etc. A diagnosis is furnished with descriptions of two species.

——— On *Ephedra*. A. N. H. ser. iii. ix. 421, x. 133. (To be continued.)

MILDE, J.—Wissenschaftliche Ergebnisse meines Aufenthaltes bei Meran. Bot. Z. 1826, p. 429. Referring chiefly to the Muscology of the district. The first chapter is upon the general character of the phanerogamic vegetation.

Miquel, F. A. W.—Flora Brasiliensis, fasc. 32. Sapotaceae. With 33 plates. The new genera are *Passaveria* (*Ecclinusa*, olim Hb. Mart. Bras.), with the *facies* of *Lucuma* and flowers of *Chrysophyllum*, and *Oxythece*, Miq. with the flowers of the latter, and habit of *Sideroxylon*, but with exalbuminous seeds.

——— Remarques sur la genre *Nania.* Miq. Journ. Bot. i. 292. With 1 pl. *Nania* is a genus of Myrtaceae, with the habit of *Eucalyptus*, but with tetramerous flowers, and an ovary almost free, growing in the Indian Archipelago. It is based on *Metrosideros vera*, D.C.

——— Over die geographische verspreiding der Ficeae, met een nader onderzoek omtrent de soorten, welke in America, noordelijk van de landergte van Panama, voorkommen. Amsterd. Versl. K. Ak. 1862, xiii. p. 382.

Möhl, Hein.—Morphologische Untersuchungen über die Eiche. Cassel. 1861. pp. 35. 4to. 3 plates.

Mohl, H. v.—Einige anatomische und physiologische Bemerkungen über das Holz der Baumwurzeln. B. Z. 1862, p. 225 continued to 321. Upon the ill-understood structure of the roots of trees, and the relation of their structure to that of the trunk. Coniferae and deciduous trees are treated separately; *Abies pectinata* being selected as presenting the characteristic distinctions of root and stem-structure most plainly in the former—the Ash, *Fraxinus excelsior*, among the latter. Special reference is made to certain errors of Schacht's (Anat. u. Physiol. d. Gewächse) as to the above. The root of the *Abies* differs from the stem in the following particulars:—1. In the smaller thickness of the annual zones and greater softness of the wood. 2. In the opposing structure of thick and thin zones. In the stem the outer portion of the annual rings, consisting of thick-coated cells, is the wider, the narrower the entire zone, while in the root the conditions are reversed; the more solid portion of the zone being thicker in thin rings; when they are very thin it almost entirely disappears. 3. In about one-fourth greater radial and one-fifth greater tangential diameter of the wide cells of the inner portion of the annual zones; and, 4th, the greater radial diameter, and broader cavity of the outer cells. 5th. The greater length of the cells of the innermost, soft portions of the root. Modifications of the above relations are detailed in *Pinus sylvestris*, *Larix europea*, and *Picea vulgaris.* In the Ash the greater or less thickness of the annual rings is accompanied by corresponding and very considerable differences in their structure. These differences, in the layers making up each ring, are described. The rings of the stem are usually thicker than those of the root, while the wood of the latter is softer and more spongy; the cells being broader and with thinner walls. Modifications of structure are described in the Beech, Oak, Birch, Aspen, and Barberry.—P. 258 et seq. the principal contrasts of root and stem-structure are reviewed. The last division of the essay is devoted to the relation of the period of growth in the root and stem. It is shown that after growth in the stem has ceased with the setting-in of winter, the development of the root is continued without interruption. Climate and temperature of the soil are considered in relation to this activity of the root; also the practical question, whether autumn or spring is best suited for transplanting.

MOHL, H. v.—Einige erläuternde Bemerkungen zu der von Prof. Schacht gegen meine Darstellung des Coniferenholzes erhobenen Reclamation. Ibid. 460. Pointing out that Schacht's measurements, made with a view to determine the relation of stem and root wood-cells, are based upon the cells of branches, the microscopic structure of which is considerably different from that of the trunk.

MONTROUSIER.—Die Flora der Insel *Art* bei Neu-Kaledonien. Flora, 1862, p. 343. (Ext. Mem. Ac. Lyon. 1860.) This paper contains descriptions, such as they are, of no fewer than 26 "new genera." Having hitherto made a point of noticing all such appearing in the Journals, etc., which come within our reach, we copy out M. Montrousier's new names, premising that it is highly probable that none, or but few, of them are tenable, though, from the imperfection of the descriptions, it is impossible to say with certainty. *Vanieria*, *Quinsonia* (Pittosporeae), *Seresia* (Violarieae?) *Huonia* and *Oxanthera* (Aurantiaceae), *Dugezia* (Hypericineae), *Apiocarpus* (Sapindaceae), *Bouzetia* (Diosmeae), *Vieillardia* and *Mac-Leayia* (Leguminosae), *Pockornya* and *Tomostylis* (Lythrarieae?), *Chiralia*, *Balardia*, *Draparnaudia*, *Mooria* (Myrtaceae), *Thiollierea*, *Figuierea*, *Delpechia*, *Douarrea*, *Pogonanthus* (Rubiaceae?), *Panchezia* (*Ixora?*), *Maoutia*, *Rapinia* (Verbenaceae?), *Entrecasteauxia* (Myoporineae), *Timeroyea* (Nyctagineae?)

MOORE, D.—Results of farther Physiological Experiments on the formation of Wood in Dicotyledonous Plants, made in the Royal Dublin Society's Botanic Garden, between the years 1851 and 1860. Proc. R.I.A. 1860, p. 162. Confirmatory of Trécul's observations in Ann. des Sciences on the Growth of Wood in Dicotyledons. No new facts are recorded.

MORE, A. G.—On the Discovery of *Gladiolus Illyricus* (Koch) in the Isle of Wight. Linn. Proc. Bot. vi. p.177. Identical with the plant growing in the New Forest, which is found to differ from *G. communis*, to which it had previously been referred.

MORIÈRE, J.—Quelques observations critiques sur les espèces du genre *Monotropa*. Bull. Soc. Fr. ix. p. 97.

MUELLER, C.—Annales Botanices Systematicae (Walpers). T. vi. Fasc. 3. Lipsiae, 1862. Orchides (*Epidendrum* § 2. *Encyclium* to *Elleanthus*). A new feature is the frequent introduction, under the specific diagnoses, of untranslated and unabridged newspaper remarks, from the Gardener's Chronicle, etc., upon the respective species.

Mueller, F.—Fragmenta Phytographiae Australiae. Vol. ii. The new genera proposed are *Emblingia* (Capparideae); *Hannafordia* (Sterculiaceae); *Cadellia* (Simarubeae); *Ixiosporum* (same as *Citriobatus*), and *Hymenosporum* (Pittosporaceae); *Petermannia* (Dioscoreaceae or Smilaceae); *Agrostocrinum* and *Hodgsonia*, altered to *Hodgsoniola* in Appendix (Liliaceae); *Hodgkinsonia* (Rubiaceae); *Wittsteinia* (Vaccinieae); *Ethuliopsis*, *Acanthocladium*, *Cyathopappus* (Compositae).

——— A Systematic arrangement of the Plants noticed around the Gulf of Carpentaria, from the Roper to the Gilbert River. Melbourne, 1862, 8vo. pp. 16. A list of the species, including those collected on Landsborough's Expedition.

Murray, A.—Monographic Sketch of the Conifers of Japan. Proc. Hort. Soc. ii. 265, 409, 496, 633, 719. With cuts.

Nägeli, C.—Die Anwendung des Polarisationsapparates auf die Untersuchung der vegetabilischen Elementartheile. Münch. Sitzb. 1862, 8 März. On Doubly refracting spheres contained in the epidermal cells of the Apple, and on the Protein crystalloid of the Paranuss (Brazil nut).

——— Beobachtungen ueber das Verhalten des Polarisirten Lichtes gegen Pflanzliche Organisation. Münch. Sitzb. 1862, p. 290.

——— Gefrieren und Erfrieren. Flora. 1862, p. 203. Referring to the observations of Sachs; Flora, p. 17.

Naudin, C.—Espèces et variétés nouvelles de Cucurbitacées cultiveés au Muséum d'Histoire Naturelle, en 1860 et 1861. A. S. N. ser. iv. xvi. p. 154. i. New races and varieties of already published species. ii. New or imperfectly known species. The genus *Scotanthus* is based on the *Bryonia cochin-chinensis*, Lour. *Melangium* and *Abobra* are new genera, founded on So. American plants. M. Naudin proposes the following provisional sections of the order Cucurbitaceae, excluding *Zanonia*, *Nhandiroba*, and *Feuillea*, which require further examination, and may prove types of distinct groups.

1. *Cucumerineae.*—Ovary bi-trilocular (or rather with 2 or 3 placentas); ovules and seeds transverse, usually indefinite.
2. *Cyclanthereae.*—Ovary with a single placenta (although possibly tricarpellary); ovules inserted transversely, or slightly oblique.
3. *Abobreae.*—Ovary tricarpellary (or perhaps also of fewer carpels); ovules usually definite and erect.
4. *Sicyoïdeae.*—Ovary 1-2-3-carpellary. Ovules definite, usually solitary and suspended.

Neumann, L.—Note sur la culture et la Greffe des *Luculia*. Adans. ii. p. 198. Neumann is attempting to graft *Luculia* (Rubiaceae) upon certain genera of Caprifoliaceae. His experiments are not decisive. The grafts succeeded upon *Rogiera*. Observations are added upon the distinctions between Rubiaceae and Caprifoliaceae.

Neumann, L.—Des causes qui determinent les brulures et les taches des feuilles, spécialement dans les Serres. Adans. ii. p. 312. Pointing out that drops of water upon leaves exposed to the sun may act as condensing lenses, burning the leaf.

Nobbe, Fr.—Ueber die feinere Verästelung d. Pflanzenwurzel. Dresden, 1862. 8vo. On the relation of the development of the root-fibrils to the nutrient matter contained in the medium traversed by the axes from which the fibrils are given off.

Nyman, C. F.—En ny art af slägtet *Astrocarpus*. Stock. Förhandl. p. 191. With 1 Plate. *A. cochlearifolius* from South Portugal.

Oersted, A. S.—Myrsineae Centro-Americaneae et Mexicanae. Vid. Medd. Kjob. 1861, p. 117.

——— Et Bigrag til Træernes Architectonik. 8vo. pp. 29. The principal architectonic types recognisable in trees are the *columnar*—as in Arborescent Monocotyledons; the *conical*, *pyramidal*, or *tapering*, in Coniferae; the *subumbellate*, the poplar, &c.; the *knotty-sinuous*, the oak, &c. and the *arched* type, as in the beech. (Bull. Soc. Bot.—*Rev. Bibl.* Oct. 1862.)

Oliver, D.—Note on the Structure of the Anther. Linn. Trans. xxiii. p. 423, (with 1 plate). Confirming and extending the views of Bischoff, that the sutures of the anther do not correspond to the margins of the stamen-leaf. It is advanced that the sutures "answer to the lines of junction of outer and inner thickened portions of the lamina on either side of the midrib." Mr. Oliver's arguments are chiefly based upon an abnormal condition of the stamens in a species of *Geranium*.

——— Note on *Hamamelis* and *Loropetalum*; with a Description of a new *Anisophyllea* from Malacca. Ibid. p. 457. Favouring the generic separation of *Loropetalum* from *Hamamelis*. A Synopsis of the uni-ovulate genera of Hamamelideae is given. *Anisophyllea* is considered to be nearer to Rhizophoraceae, to which Mr. Bentham referred it, than Hamamelideae or Barringtonieae, amongst which it has been located by some botanists.

——— The Atlantis Hypothesis, in its Botanical Aspect. Rep. Roy. Inst. 7 March, 1862. N. H. R. 1862, p. 149.

Oudemans, C. A. J. A.—Mémoire pour servir de réponse à la question: si les stomates dérivent de cellules épidermiques ou bien de cellules parenchymatiques sous-jacentes? Amsterd. Versl. K. Ak. 1862, xiv. p. 318 (with a plate). The stomates are modified epidermal cells; they are not derived from the subepidermal layer. The mother-cells of the stomates, when they first become perceptible, are always in the plane of the epidermis, their upper wall not being depressed below that level. With regard to the cavity beneath the stomate, in *Agave* and *Aloë*, M. Oudemans finds that it does not originate prior to the division of the nucleus of the superimposed mother-cell.

——— Das Hornprosenchym Wigand's. Bot. Zeit. 1862, p. 43. Claiming priority in recognizing the presence of this tissue, having described and figured it from *Canella* in 1855.

PAPPE, L.—Silva Capensis. A Description of So. African Forest Trees and Arborescent Shrubs, used for Technical and Economical purposes. Ed. ii. London, 1862.

PARIS, E. G.—Sur les *Verbascum* de la Flore de Chambéry. Bull. Soc. Bot. vii. p. 842.

PARLATORE, Ph.—Sur les Cônes des Conifères. L'Inst. 1481, p. 164, and A. S. N. ser. iv. xvi. 215 (with figs.) Monstrous cones of *Abies Brunoniana*, in which the scales were transformed into leaf-bearing branches. From the various modifications in length, and union of these organs, M. Parlatore is led to regard the fruit-scale as formed of the connate leaves of an axillary branch, the axis of which remains extremely short. He is also of opinion, that in several genera of Coniferae, the leaves are adnate to the branches through a portion of their extent; that which is generally taken as the leaf being but its apical portion.

PARODI, D. — Observaciones botanico-quimicas sobre una nueva especie de "Acacia," cuyo fruto puede reemplazar las agallas. Rev. Farm. (B. Aires) iii. p. 4. On a Paraguayan *Acacia*, the fruit of which may be substituted for galls. An analysis is given.

PARRY AND ENGELMANN.—Coniferae collected by Dr. Parry in the Rocky Mountains. Am. Journ. ser. ii. xxxiv. p. 330.

PERRIER, A.—Sur le *Primula variabilis*. Bull. Soc. Linn. Norm. vi. (Extr. 1861).

PETER, H. — Untersuchungen über den Bau und die Entwickelungsgeschichte der dicotyledonischen Brutknospen. Göttingen. 1862, 8vo. pp. 40 (with 2 plates). On the bulbels of Dicotyledons; the diverse structure, &c. of which is illustrated by a primary reference to those of *Polygonum viviparum*, *Oxalis Deppei*, *Saxifraga granulata*, and *Dentaria*.

PETERS, W. C. H.—Naturwissenschaftliche Reise nach Mossambique. Botanik. 1 Abth. 4to. Berlin, 1862. (With 48 plates.) New genera described are, *Gorskia*, Bolle (*Swartzieae*); *Capassa*, Kl. (*Dalbergieae*); *Lepidanthemum*, Kl. (*Melastomaceae,—Heterotis* of Benth. in Fl. Nig.); *Hitzeria*, Kl. (*Anacardiaceae*); *Calyptrospatha*, Kl. (*Acalypheae*); *Argyrodendron*, Kl. (*Crotoneae*); *Acanthocarpea*, Kl. (*Phytolaccaceae*); *Clemanthus*, Kl. (*Passifloreae*); *Chlanis*, Kl. (*Bixaceae*); *Chilocalyx*, Kl., *Decastemon*, Kl., *Symphyostemon*, Kl., *Dianthera*, Kl., *Anomalostemon*, Kl., *Physanthemum*, Kl., and *Petersia* (*Capparidaceae*); *Gerardianella* (*Scrophulariaceae*); *Calycanthemum*, Kl. (*Convolvulaceae*); *Meristostylus*, Kl. (*Gentianeae*); and *Agathisanthemum*, Kl. (*Cinchoneae*).

PEYRITSCH, J.—Zur Kenntniss der Gattungen *Rhynchelythrum* und *Monachyron*. Bot. Zeit. 1862. p. 3.

PLANCHON, J. E.—Note sur les *Ægilops ovata* et *triticoides*. Bull. Vaud. vii. p. 231.

PLANCHON, J. E. and G.—Note sur les Observations faites au Jardin des Plantes de Montpellier pendant l'éclipse du 18 Juillet,

1860. *Mammillaria setosa, Mesembryanthemum album, Oxalis floribunda, Mammillaria rhodantha, Portulaca grandiflora,* and *Oxalis Deppei* closed their flowers, more or less, during the eclipse. The leaves of *Amorpha fruticosa, Indigofera dosua, Robinia viscosa, Glycyrrhiza glabra,* and 3 spp. *Acacia* were affected. Sensitive plants are also named which were not affected.

PLANCHON, J. E.—Observations sur les Cistinées. Bull. Soc. Bot. ix. p. 509. 1. Nature of the parts forming the calyx. According to some observers the two outer sepals are regarded as accessory bracteoles, answering to stipules; one chief ground upon which this view rests being the lateral position of the bract at the base of each pedicel. M. Planchon shews this to be due to the cymose, unilateral character of the inflorescence, and regards the reduced outer lobes of the calyx as true sepals. 2. Symmetry of calyx and corolla. 3. Hybridisation of Cistineae. The remarkable fixity of the characters of *Cistus Ledon* is pointed out. The anthers of this hybrid are stated to be habitually sterile.

PLANCHON, J. E. and I. TRIANA.—Réponse aux critiques de M. le Prof. Grisebach relativement aux genres *Rheedia* et *Mammea.* A. S. N. ser. iv. xv. p. 236.

——— Mémoire sur la Famille des Guttifères. A. Sc. Nat. iv. ser. xvi. p. 263. Chapitre ii. Devoted to the Organology and Physiology of the Order. Under the heads of the several organs, &c. are many valuable observations, especially upon the floral symmetry and the structure of the seed. In respect to the former, the authors write:—"En résumé, les Guttifères sont une de ces familles multiformes et à tendances multiples chez lesquelles se rencontrent, pour se relier l'un à l'autre, les types d'organisation florale qui semblent ailleurs les mieux tranchés. Décussation parfaite avec répétition de verticilles dimères ou trimères; calyce et corolle pentamères avec alternance suivant la règle ordinaire: voilà les états extrêmes. Passage de la décussation à la spire oblique, de la dimérie à la trimérie et à la pentamérie; de l'imbrication à l'estivation convolutée; traces de dédoublement latérali-interne, tout cela compliqué d'irregularités fréquentes de transpositions dans le rang des pièces, de variations dans leur ordre de superposition ou d'imbrication, voilà la part des nuances et naturellement des difficultés. Ces difficultés nous les signalous sans avoir la prétóntion de les résoudre, et sans vouloir condamner absolument les théories auxquelles elles semblent faire brèche." The seed presents many remarkable features of interest, and, as we have already noted (*vide* N. H. R. 1862, p. 456), furnishes characters for the division of the Order into Tribes. Its details are discussed at length under the respective heads of (1.) Direction of the seeds: relative position of the raphe. (2.) General composition of the ovules and seeds. (3.) Ovular and seminal integuments—the aril, arillode, testa; albumen, embryo, and germination. (*vide* N. H. R. 1863, p. 373.)

Pollender, A.—Chromsäure ein Lösungsmittel für Pollenin und Cutin, nebst einer neuen Untersuchung über das chemische Verhalten dieser beiden Stoffe. Bot. Zeit. 1862, p. 385. Announcing chromic acid as a solvent of cuticle and the extine of Pollen-granules.

Prillieux, Éd.—Observations sur une fleur dimère de *Cattleya amethystina*. Bull. Soc. Bot. ix. p. 275. Each verticil of the perianth consisted of two opposite segments, the verticils decussating. The two inner lobes each presented the form of a normal labellum. The relation of this dimerous form to the genus *Mælenia* of Dumortier is pointed out.

Puel, T.—Revue Critique de la Flore du Département du Lot (suite). Bull. Soc. Bot ix. p. 399.

Rand, E. S. jr.—The Heather (*Calluna vulgaris*) a native of the United States. Am. Journ. xxxiii. (1862), p. 22. Notice of a station within 20 miles of Boston. It is regarded as indigenous.

Regel, E.—Flora der Gebiete des Russischen Reiches oestlich vom Altai bis nach Kamtschatka und dem Russischen Nordamerika, nach den von G. Radde und andern gesammelten Pflanzen bearbeitet. Bd. i. Hft. 2. Moskau. 1862. Violarieae to Caryophyllaceae (*Spergularia*). Of many of the more critical and variable genera, subgenera, and species, a Conspectus, or Synopsis, is given of the species, varieties, or forms, as the case may be, which they include, as *Viola*, *Parnassia*, *Polygala*, *Lychnis*, sect. *Gasterolychnis*. In the genera or subgenera, these are generally limited to the species of the Russian empire.

——— Flora Ussuriensis. St. Petersburg, 1862, 1 vol. 4to. pp. 282, with 12 plates.

——— Ueber Betulaceen. Bot. Zeit. 1862, p. 100. Observations upon Prof. Grisebach's criticisms of the author's Monograph of Betulaceae.

——— Noch einmal *Betula alba*, L. und deren Abarten *B. alba-verrucosa* und *pubescens*. Ibid. p. 329.

——— Conspectus specierum generis Aconiti quae in Flora Rossica et in regionibus adjacentibus inveniuntur. A. S. N. ser. iv. p. 144. (*vide* N. H. R. ii. p. 458.)

——— *Vide* Maximowicz.

Reichenbach, H. E. (fil.)—Icones Florae Germanicae et Helveticae. Vol. xx. *Linaria* to end of volume, including remainder of Scrophulariaceae, Orobancheae, Acanthaceae, Globularieae, Lentibularieae.

——— Xenia Orchidacea. Vol. ii. pts. i. ii. Leipzig, 1862. New genera taken up from the author's descriptions in Otto's Hamb. Gartenzeit. 1860, are *Stauropsis* and *Grammangis* (the latter near *Grammatophyllum* and *Cymbidium*). This part includes a review of the genera *Phalænopsis*, *Doritis*, and *Stauropsis*. The genus *Esmeralda* is based upon *Vanda Cathcarti*, Lindl.

——— Kleinere Mittheilungen: 1. *Hieracium Medusae;* and 2. Dimorphism and Dichromism of an Orchid (*Vanda Lowei*, Ldl.) Bot. Zeit. 1862, p. 62. The lowest three flowers of the inflorescence of the Orchid were larger than the rest, the segments of the perianth bright orange-yellow, with small purple spots; in the smaller flowers, the perianth-segments differed in form, and were marked with large cinnamon blotches, on a yellow-green ground.

Reichenbach, H. E. fil.—*Cleisostoma Guiberti*, Ldl. et Rchb. Ibid. p. 375. *Rodriguezia pardina*, p. 428.

——— Neue Orchideen. Ibid, p. 214. Mostly East Indian species, with descriptions.

——— *Dendrobium Mohlianum*. Bonpl. 1862, p. 334 (with 1 plate). From mountain summits in the Fijis.

——— Trias Orchidacea Philippensis. Ibid. p. 335. *Cleisostoma*, *Louisia*, and *Cypripedium*.

Reinsch, P. F.—Anatomisch-physiologische Fragmente (Fortsetzung). Linnaea, xv. p. 195. 3. On the structure of the Cilia of the leaves of *Draba aizoides*, and the thickening of their cell-wall.

Reuss, G. Ch.—Pflanzenblätter in Naturdruck mit der botanischen Kunstsprache für die Blattform. Stuttgart, folio.

Rochebrunne, A. De.—Recherches sur le *Clandestina rectiflora*. Bull. Soc. Bot. ix. p. 258. Showing the plant to be parasitical upon species of twelve Nat. Orders, both Di- and Monocotyledonous.

——— De l'avortement des pétales du *Ranunculus auricomus*. Ibid. p. 280.

——— Nouvelles remarques sur le *Primula variabilis*, with further arguments against its being a hybrid form. Ibid. p. 235.

Rochleder, Fr.—Untersuchung der reifen Samen der Rosskastanie (*Aesculus Hippocastanum*). Wien. Sitzb. xlv. p. 675.

Rossmann (J.)—Zum Verständniss der *Delphinium*-Blüthe. Bot. Z. 1862. p. 188.

Sachs, J.—Ueber die Stoffe, welche das Material zum Wachsthum der Zellhäute liefern. Pringsh. Jahrb. iii. p. 183. 1. Micro-chemical methods of observation. 2. The general behaviour of substances forming cellulose during the growth of the cell-membrane. 3. The 'Starch-layer,' the tissue accompanying and partially or completely surrounding the vascular bundles of the stem, petiole and leaf, and which, with some exceptions, abounds more or less in starch granules. 4. Starch in Chlorophyll. 5. Starch in young organs. 6. On the behaviour of starch, and the transitional products resulting from it during germination. 7. Starch and sugar during the vegetative period, from completed germination to time of flowering. 8. Starch, sugar, and oil, during the maturation of the fruit. 9. The occurrence of starch, oil and sugar, in various tissues. 10. The migration of starch, etc. 11. Historical appendix.

——— Zur Keimungsgeschichte der Gräser. Bot. Z 1862. p. 145. With 1 plate.

SACHS, J.—Zur Keimungsgeschichte der Dattel. Ib. p. 241, 249. With 1 plate. An enquiry into the way in which the nutritive matter of the albumen is appropriated during germination. Sachs finds that both the nitrogenous and non-nitrogenous formative matter of the albumen are transferred to the embryo through the means of the absorbent epithelial layer of cells of the "corpus cotyledoneum" (*Saugorgan*); the latter—cellulose and oil—being found in the embryo, under the form of grape-sugar and starch. These materials, accumulated in the albumen in the same cells, and indeed absorbed by the same epithelial layer, separate in the germinating embryo; the albuminous substances being conveyed through the thin-walled cells of the vascular bundles, to the site of active formation of tissue; the non-nitrogenous finding their way through the parenchym, especially those layers which immediately surround the vascular cords.

——— Ueber saure alkalische und neutrale Reaktion der Säfte lebender Pflanzenzellen. Ibid. 257.

——— Ueber den Einfluss des Lichtes auf die Bildung des Amylums in der Chlorophyllkörnern. Ibid. p. 365. The author's observations agree generally with those previously recorded by Böhm and others, upon the relations of starch and chlorophyll, and lead him to the opinion that starch in chlorophyll-granules may be regarded not only as a secondary deposit, but as a product of the assimilative activity, under the influence of light, of the chlorophyll substance. Amongst Hr. Sachs 'assured results,' are the following:—1. During germination in the dark or twilight the starch of albumen or cotyledons becomes completely consumed, while the leaves, root, etc. develope. 2. If the plant remain under the above conditions it ceases to grow, and at length perishes. 3. In the mesophyllary cells of the cotyledons and first leaves there is found, at first applied to their walls, a layer of protoplasm which afterwards resolves itself into chlorophyll-granules. These are yellow in the dark, green in a dim light, pale green in full light. 4. If a plant, germinated in darkness, be exposed to the light, the yellow granules become green; if the light suffice in intensity and duration, starch forms in the chlorophyll granules; if it be insufficient, the latter become green without forming starch, and at length the plant perishes as in the dark. 5. From the circumstance that the first formation of starch takes place in chlorophyll, and that only chlorophyll-containing organs have the power of liberating oxygen, it follows that the starch is formed by assimilation from inorganic elements, while, on the other hand, the starch in uncoloured organs is developed from organic materials elaborated in the chlorophyll-containing cells, from which they are transmitted.

——— Ergebnisse einiger neueren Untersuchung über die in Pflanzen enthaltene Kieselsäure. Flora. 1862. pp. 33, 49, 65. It is shown that v. Mohl's observations establish the general rule that those portions of a plant which are most directly subject to the influence of the air are the most strongly silicified. From an experiment upon Maize, the author finds silica to bear a very different relation to the nutritive processes of a siliceous plant than do phosphorus, sulphur, alkalies or lime. He found this plant to attain its usual height, and bear several large leaves and a spike with seeds capable of germination, with only ·7 per cent. of silicic acid in the ash; this was taken up from the glass vessel in which the plant was grown. Maize-straw grown with free access to silica, contains 18-23 per cent. in its ash.

Sachs, J.—Uebersicht der Ergebnisse der neueren Untersuchungen über das Chlorophyll. Ibid. pp. 129, 177. This review of the recent literature of Chlorophyll is drawn up with a view to sift the satisfactorily established data from those which are incomplete and uncertain. The chapters are, 1. The structure of Chlorophyll. 2. Its origin. 3. Its granular contents. 4. The green colouring matter of chlorophyll. 5. Its optical peculiarities. 6. Influence of light on the origin and alteration of chlorophyll.

——— Mikrochemische Untersuchungen. Ibid. p. 289.

Sadler, J. and W. Bell.—Note in reference to the Bursting of the Spathe of *Seaforthia elegans*. Trans. Bot. Soc. Ed. p. 268.

Sagot, P.—Principes généraux de Geographie Agricole. Rev. Monde Col. 1862.

——— Explication Physiologique de la mauvaise végétation des légumes des pays tempérés sous l'équateur. Bull. Soc. Bot. ix. p. 147. M. Sagot finds that while the abundant light, medium humidity and moderately active vegetation of the temperate zone are coupled with vegetable products rich in albuminous matter; in the tropics great heat, abundant moisture and luxuriant vegetation afford products relatively poor in albumen. The results of his enquiry into the causes to which the difference is due are here detailed.

Sass, A. v.—Die Phanerogamen Flora Oesells und der benachbarten Eilande. Arch. Nat. Kurlands, etc. Bd. ii. p. 575.

——— Beitrag zur Flora der Insel Runoe. Ibid. p. 647.

Schacht, H.—Ueber der Stamm und die Wurzel der *Araucaria Brasiliensis*. Bot. Zeit. 1862. p. 409. With 2 plates. A minute account of the anatomy of the wood of the root and trunk, with reference to criticisms of Von Mohl.

Schaeffer, G. C.—On a remarkable form of rotation in the pith-cells of *Saururus cernuus*. Am. Journ. xxxiv. p. 400. The author finds in the smaller cells forming the middle of the partitions separating the air-canals of the pith, a motion of granules (of unknown composition), closely resembling that well-known in the terminal vesicles of *Closterium*. This, however, we have always regarded as something very different from the so-called 'swarming' of Gonidia in the freshwater Algae with which Dr. Schaeffer seems to confound it. He regards the phenomenon in *Saururus* as in connection with active vitality and capacity for division.

SCHEELE, AD.—Revisio Hieraciorum Hispanicorum et Pyrenaicorum. Linnaea. xv. p. 637.

SCHLECHTENDAL, D. F. L. v.—Abnorme Bildungen. Bot. Zeit. 1862. p. 4. 1. *Aquilegia vulgaris*, with spirally twisted carpels. 2. A leaf of *Prunus Cerasus.* 3. Nervation of a three-pointed leaf of *Populus balsamifera.* 4. Forked nervure of a bifid leaf of *Nerium Oleander.* 5. Nervation of leaf of *Glaucium luteum.* 6. Bifid awn of *Lolium temulentum.*

——— Abnorme Bildungen an Pflanzen. Ibid. p. 301. Case of Prolification in *Lilium.* Ibid. p. 382. Median prolification of *Cyclamen.*

——— Abnorme Fruchtbildungen. Ibid. p. 405. In *Juniperus* and *Crataegus.*

——— Plantae Kegelianae. Linnaea. xv. p. 314. With amended descriptions of several *Cyperaceae,* also of one or two new species.

——— Beitrag zur Flora von Böhmen. Ibid. A list of species, with notes as to their frequency, etc., headed *Florula Ginetzensis.*

——— Die Gattung *Hymenachne,* P. B. Ibid. p. 348.

——— Ueber *Setaria,* P. B. Ibid. p. 387.

——— Ueber *Lonicera Xylosteum* und deren Abänderungen. Ibid. p. 632.

——— Bemerkungen über einige Ribes-Arten. Ibid. p. 729. Critical observations upon *R. petraeum, R. spicatum,* and allies.

SCHLICKUM, J.— Ueber die chemischen Vorgänge beim Reifen der Weintraube. Pollichia, xviii.-xix. p. 41.

SCHLOTTHAUBER, DR. — Merkwürdige Fruchtbildung bei einer Möhrenpflanze (*Daucus Carota*). Bonpl. 1862. p. 300.

SCHMIDT, FR.—Flora der Insel Moon, nebst orographisch-geognostischen Darstellung ihres Bodens. Arch. Nat. Kurlands, etc. i. p. 1.

SCHMIDT, J. — Florae Brasiliensis Scrophularinae. (Fasc. xxx. Martius; Flora Brasiliensis) Lipsiae, 1862. Tabb. 39-57. No new genera are described. Chapters on the geographical distribution, and economic applications of the Order, by Von Martius are appended.

SCHONBEIN, HR.—Ueber die Erzeugung des Saltpetrichten Ammoniakes aus Wasser und atmosphärischer Luft unter dem Einflusse der Wärme. Münch. Sitzb. 1862. p. 45.

SCHOTT, H. G.—Neue Brasilische Aroideen. Bonpl. 1862. p. 5. Descriptions of 4 new species.

——— Neue Brasilische Aroideen. Ibid. p. 86. Descriptions of new species.

——— Aroideologisches. Ibid. p. 147. Descriptions of an *Arum* (*ponticum*) and 3 species of *Anthurium.*

——— Aroideologisches. Ibid. p. 222. A description of the new genus *Lysistigma,* founded on a plant of doubtful Peruvian origin. The genus *Steudnera,* C.K. is also described.

——— Neue brasilische Aroideen. Ibid. p. 322. Two new species are described.

——— Aroideologisches. Ibid. p. 346. Descriptions of three new species.

SCHÜBELER, F. C.—Die Culturpflanzen Norwegens. Christiania, 1862. 4to. pp. 197. With 24 plates. Also, (extracted from the same), Synopsis of the Vegetable Products of Norway. 4to. pp. 31. The latter work is intended as a guide to the vegetable products of Norway exhibited in London, 1862. It includes several interesting phyto-geographical observations. In respect of the cultivation of southern species in northern latitudes the author states the following results from his observations, which have extended over several years. Corn will ripen at a much lower temperature and in shorter time in Norway than in countries further south. If the seed be brought from a northern climate it will require at first a longer time to ripen than the same species cultivated in the north for a longer period, though after two or three years it will ripen at the same time. On the other hand, M. Schübeler remarks that if seeds be brought from a higher to a lower latitude they will, at first, ripen earlier than plants of the same species of the corresponding lower latitude, which have not been thus removed. Provided a species be not cultivated further north than it is able to attain a full development, the seed increases in size and weight for the first two or three years, the nearer it approaches this limit; it diminishes, in like manner, if cultivated further south. Again, the further north a plant is cultivated the deeper becomes the colour of the epiderm. This applies to the testa of peas and beans, and the petals of flowers. The foliage of both wild and cultivated species is remarkable for a greater brightness and verdure in the north. Roots, leaves, seeds and fruits, containing aromatic matter, develop it to a very striking degree the further they are found to the north. Even the Bird-cherry, Mountain-ash, and Lily-of-the-Valley, are characterised by stronger aromatic properties near Throndhjem than at Christiania. The above phenomena the author attributes to the influence of the longer days of northern latitudes; though whether to the heating or actinic solar rays—or both—or to some other influence—he leaves to further investigation.

SCHULTZ (*Bipont*), C. H.—*Pertya scandens*. Bonpl. 1862, p. 109. With 1 plate. *Pertya* is a new genus of Mutisieae from Japan, perhaps identical with Thunberg's *Erigeron scandens*.

——— Ueber Cassiniaceae uniflorae. Poll. xviii-xix. p. 157.

——— u. F. W.—*Pilosella* als eigene Gattung aufgestellt. Flora, 1862, pp. 417, 433. *Pilosella* is separated generically from *Hieracium*. The species are enumerated, sundry observations being added. *Heteropleura*, a new genus of Cichoraceae, is described.

——— Novum Cichoriacearum genus. Bull. Soc. Bot. ix. p. 284. *Ceramiocephalum* from Algeria, (*Lapsana virgata* of Desf.)

——— Observationes in Kalbfussiam et Fideliam. Ibid. p. 286.

——— Hieracii nova species. Ibid. p. 440. *H. grandifolium*, from Algiers.

SCHULTZ, F. G.—The Synonymy of a few species of *Mentha.* Bull. Soc. Bot. ix. p. 222.

——— Der Torf. Pollichia, xviii. xix. p. 29. The formation of peat, and the plants taking part in it.

——— Bemerkungen über zwei neuerdings von französischen Schriftstellern verwechselte pfälzer Pflanzen. Ibid. p. 34. With 1 plate.

——— Tabelle der in der Pfalz und den benachbarten Gegenden vorkommenden Arten der Gattung *Verbascum,* sowie der in diesem Gebiete bereits gefundenen und noch zu suchenden Bastarde aus derselben. Pollichia, Ibid. p. 24.

——— Berichtigung der Irrthümer, welche im Pflanzen-verzeichnisse des "Prodromus topographiae medicae Weissenburgensis auct. P. F. Buchholtz" enthalten sind. Ibid. p. 63.

——— Ueber das "Herbarium normale" von (anon.) Ibid. p. 74.

——— Botanisch-geologische Reise ins Nahethal. Ibid. p. 128.

SCHULTZ, F.—Zusätze und Berichtigungen zu meiner Flora der Pfalz. Poll. xviii. xix. p. 75.

——— Diagnosis novae speciei *Cerastii* generis. Flora, 1862, p. 458.

——— Ueber *Gagea andegavensis* und *Potentilla Bogenhardiana.* Ibid. p. 459.

——— Ueber *Melica Glauca* und *Schistostega.* Ibid. p. 461.

SCHULTZ - SCHULTZENSTEIN.—Vorträge uber die Entstehungsgeschichte der Lebenssaftgefässe. Flora, 1862, p. 83. Various reasons are given to show that laticiferous 'vessels' do not originate from rows of cells, or from any metamorphosis of cells.

SCHWEINFURTH, G.—Plantae quaedam niloticae quas in itinere cum divo Adalberto libero Barone de Barnim facto collegit R. Hartmann. Berol. 1862. 4to. pp. 53. tabb. 16. No new genera are described. Principally an enumeration of species, with localities.

SEEHAUS, C.—Ist die Eibe ein norddeutscher Baum? Bot. Zeit. 1862, p. 33. On the nativity of the Yew in North Germany.

SEEMANN, B.—On *Hanburia,* a Cucurbitaceous Genus from Mexico. A. N. H. ser. iii. ix. p. 9. With an emended character of the genus.

——— On *Antiaris Bennettii,* a new species of Upas Tree, from Polynesia. Ibid. p. 405. Description of the plant figured in 'Bonplandia,' 1862, t. 7.

——— Remarks on the Natural Order *Bignoniaceae.* A. N. H. ser. iii. ix. p. 192. In reply to Mr. Miers' criticisms, and vindicating the "integrity of the Crescentiaceae," as circumscribed in the author's synopsis.

——— Note on the Relationship of *Cannabinaceae.* Ibid. p. 199. Suggesting an affinity with Malpighiaceae and Acerineae, especially the former.

——— Revision of the Natural Order Bignoniaceae. A. N. H. 3rd. ser. x. 29. Embracing a list of the genera, grouped under three Tribes:—*Eubignonieae,* capsula marginicida, septum valvis parallelum; *Catalpeae,* loculicida, septum valvis oppositum; *Jacarandeae,* marginicida, septum valvis oppositum. All the cirrhose Bignoniaceae are American, excepting *Dolichandra,* and belong to the tribe *Eubignonieae.* The erect species, excepting two Asiatic genera, belong to the other tribes. *Tecomella* (*Tecoma undulata*), Don, and *Campsidium* are new genera proposed.

SEEMANN, B.—Ueber *Kelletia* und *Prockia.* Bonpl. 1862, p. 18. The genera are identical.

——— *Lindenia Vitiensis,* Description and Figure of, Ibid. p. 33.

——— *Smythea pacifica.* Genus novum Rhamnacearum. Ibid. p. 69. With 1 plate. Near to *Ventilago,* but differing in form and dehiscence of the capsule.

——— *Delostoma Lobbii,* eine neue Bignoniacea von Peru. Ibid. p. 72. With synopsis of the species of the genus.

——— *Campsidium chilense,* genus novum Bignoniacearum. Ibid. p. 147. With 1 plate. Founded on the *Tecoma Guarume,* Hook. (*non* De Candolle).

——— Notizen über Südsee-Pflanzen. Ibid. p. 153. Brief critical notes on various species.

——— *Astianthus longifolius.* Ibid. p. 221. With 1 plate. With an emended description of the genus *Astianthus* (Bignoniaceae). Seemann transfers it from *Eubignonieae* to *Jacarandeae.*

——— Ueber neue und verkannte Clerodendron-Arten. Ibid. p. 249.

——— *Hanburia mexicana.* Ibid. p. 189. With a plate, and amended generic character.

——— Nutzpflanzen Californiens. Ibid. p. 264. Two Rosaceae and two Ericaceae are mentioned on the authority of Herr Benjamin.

——— *Solanum anthropophagorum.* Ibid. p. 274. Formerly used as a salad by the cannibal Fijians.

——— Ueber die Compositen-Guttung *Fitchia.* Ibid. p. 294. Its occurrence in Tahiti.

——— *Botryodendrum,* Endl.=*Meryta,* Forst. Ibid. p. 294. Identifying these genera. Six species are enumerated.

——— Plantae Vitiensis. Ibid. p. 295. An enumeration of the species collected in the Fijis by Hr. J. Storck; including a few novelties.

——— *Pritchardia Pacifica.* Ibid. p. 309. With 1 plate. A new Fijian genus of Palms, introduced into European cultivation by Seemann.

——— *Podocarpus dulcamara,* Seem. Ibid. p. 365. Identified with *P. amara,* Bl.

——— *Pimia rhamnoides* and *Disemma caerulescens,* zwei neue Südseepflanzen. Ibid. p. 366. *Pimia* is described as a new genus of Lasiopetaleae.

——— Systematic list of all the Fijian Plants at present known. App. iii. to 'Mission to Viti.' London, 1862.

SUTHERLAND, W.—On the occurrence of *Isoetes echinospora* in Scotland. Trans. Bot. Soc. Ed. p. 343.

TASSI, A.—Sulla flora della provincia senese e Maremma toscana. Sienne, 8vo. pp. 63, 1862.

TAYLOR, J.—Notice of Flowering Plants and Ferns collected on both sides of Davis' Straits and Baffin's Bay. Ed. Phil. Journ. xvi. p. 76, and Trans. Bot. Soc. Ed. 1862, p. 323. A Catalogue of species with their localities. 138 Phanerogamia and 9 Ferns are enumerated, including about 17 species of E. Arctic American, and 3 or 4 Arctic Greenland plants, new to Dr. Hooker's list.

TEYSMANN und BINNENDIJK.—Sur quelques plantes nouvelles de la flore indienne. Miq. Journ. Bot. i. p. 364.

Embryogonia ranks as generically distinct from *Combretum*, *Nyctocalos*, (Bignoniaceae) and *Anauxanopetalum* (Anacardiaceae) are new genera described. The latter is identical with *Swintonia*.

——— Ueber *Kaju Garu*, ein wohlriechendes Holz in Indien. This wood is furnished by a tree of Java and Sumatra, described as a new genus near *Aquilaria*, under the name of *Gonystylus*.

TIMBAL-LAGRAVE, M.—Observations botaniques sur quelques plantes de la *Peña blanca*. Ext. Mem. Ac. Toulouse, 5^{e} ser. vi. 1861. An account of the vegetation and geology of the Peña blanca, a mountain on the Spanish side of the Pyrenees, fronting the Maladetta. A new species of *Campanula* and a *Euphrasia* are described.

TRÉCUL, A.—Sur les sucs propres des Apocynées, des Asclepiadées et des Légumineuses. L'Instit. No. 1487, p. 215. The latex in these plants he finds in very delicate vessels associated with the liber-bundles or surrounding the pith, and not contained in the true liber-cells as asserted by Schleiden, Schacht, and others.

TREVIRANUS, L. C.—Ueber zwei Cruciferen der Rheinischen und Pfälzer Flora. Poll. xviii-xix. p. 92.

——— Ueber ein ungewöhnliches Bluhen der *Agave americana*. Rheinl. Verhandl. xix. Jahrg. p. 330.

TRIANA, J. et J. E. PLANCHON.—Prodromus Florae Novo-Granatensis, ou Énumération des plantes de la Nouvelle-Grenade, avec description des espèces nouvelles. A. Sc. Nat. Sér. iv. xvii. p. 5. With localities and brief critical remarks. The present part, arranged in the Candollian sequence of Orders, extends to Malvaceae (*Hampea*). *Tetracera* and *Delima* are united. The authors remark that it is probable the number of ovules and of carpels is not of generic value in Dilleniaceae. Eleven new species of *Guatteria* are described, and eight of *Cissampelos*. Amended descriptions are given of *Abuta*, Aubl. and *Tetrathylacium*, Pœpp. The entangled synonymy of *Capparis Breynia*, Jacq. is discussed in detail. *Cochlospermeae* are maintained as a distinct Family, and their differences from *Bixa* and its allies insisted on. *Glœospermum* is a new genus of arborescent Violaceae, near *Leonia*, but with a produced connective to the anthers: one species is described. (*vide* N. H. R. 1863, p. 373.) Ibid. p. 319. From *Pachira* (Sterculiaceae) to *Pelliceria* (Marcgravieae). Under *Marcgravia* and *Norantea mixta* are observations upon the structure of the hooded bracts of these genera. The authors do not, with Messrs. Bentham and Hooker, include Rhizoboleae and the genera *Pentaphylax*, *Stachyurus*, *Omphalocarpum*, and *Microsemma* in Ternströmiaceae.

Trimen, H.—Some localities additional to those mentioned in Dr. Bromfield's Catalogue of Hampshire plants. Phytol. 1863, p. 390.

Unger, Fr.—Wissenschaftliche Ergebnisse einer Reise in Griechenland und in den jonischen Inseln. Wien. 1862, pp. 213. 8vo. A list of the plants met with on this excursion is appended, including Cryptogams. A new *Silene* is described from Ithaca. An extended account is given of the eocene Flora of Kumi, in the Island of Euboea, many new species being figured and described. There are some critical observations on *Pinus cephalonica* and its allies in the fifth and sixth chapters.

——— Botanische Streifzüge auf dem Gebiete der Culturgeschichte. Sitzb. Wien. xlv. p. 75. (5.) Inhalt eines alten ägyptischen Ziegels an organischer Körpern.

——— Ueber die Structur einiger reizbarer Pflanzentheile. Bot. Z. 1862, p. 113. With 1 plate. A minute examination of the irritable filaments of *Centaurea Jacea*, and *C. Scabiosa*, with measurements of the amount of their longitudinal contraction on irritation and proportional increase in diameter. Prof. Unger's observations show the contractility is not accompanied by an alteration in *volume*, but in *form* of the individual cells of the irritable tissue. The structure of the filaments is described and figured.

Verlot, B.—Une nouvelle espèce de *Zinnia*. R. Hort. 1862, p. 368.

Verlot, J. B. and others.—Reports upon herborisations near Grenoble, Briançon, la Grande-Chartreuse, &c. Bull. Soc. Bot. vii. p.602 to 754.

——— Sur l'*Allium strictum*. Ibid. p. 720.

Viaud-Grand-Marais, A.—Note sur la Gemmation surnuméraire du *Carpinus Betulus*. Bull. Soc. Bot. vii. p. 839.

Vieillard, E.—Plantes utiles de la Nouvelle Calédonie. A. Sc. Nat. 4 ser. xvi. p. 28. Several new species are described. Amongst the rest 8 or 9 Ferns are in the list of comestible species.

——— Études sur les genres *Oxera* and *Deplanchea*. Ext. Bull. Soc. Linn. Normand. vii. 1862. *Deplanchea* is a new genus of Verbenaceae from New Caledonia, presenting many points of affinity with Bignoniaceae.

Wacker, H.—Uebersicht d. Phanerogamenflora v. Culm. Culm. 1862.

Weiss, A. und J. Wiesner.—Beiträge z. Kenntniss der chemischen und Physikalischen Natur des Milchsaftes der Pflanzen. Bot. Z. 1862, p. 125, pt. ii. *Euphorbia platyphylla, var.* A microscopical, chemical, and physical examination of the milky juice.

Wendland, H.—*Chamaedorea Warscewiczii*, eine neue Palme. Bonpl. 1862, p. 37.

——— Beiträge zur Palmenflora der Südseeinseln. Ibid p. 190. Three new genera of Palms are described from the Samoa Islands and Fijis—*Clinostigma*, *Pritchardia* and *Cœlococcus.*

Wicke, W.—Ueber das Vorkommen und die Physiologische Verwendung der Kieselerde im Pflanzenreiche. Bot. Zeit. 1862, p. 76. An analysis is given of the siliceous bark of the celebrated *Cauto* Tree (*Hirtella silicea,* Gris.)

——— Weitere Beobachtungen über das Vorkommen und die physiologische Verwendung der Kieselerde im Pflanzenreiche. Gött. Nachricht. 1862, p. 53. With observations upon the silica contained in the bark-layers of native trees, also in fibres used for textile purposes.

——— Beobachtungen an *Chenopodium vulvaria* über die Ausscheidung von Trimethylamin. Ibid. p. 393. Flora 1862, p. 445.

Wiesner, J.—Einige Beobachtungen über Gerb- und Farbstoffe der Blumenblätter. Bot. Zeit. 1862, p. 389. The action of alkaline reagents, &c. upon these substances.

Wigand, A.—Einige Sätze über die physiologische Bedeutung des Gerbstoffes und der Pflanzenfarbe. Bot. Zeit. 1862, p. 121.

Upon the distribution of Tannin in plants, its relation to the vital phenomena of the tissues in which it occurs, and its occurrence transitorily in relation to starch and other hydro-carbons; also upon its relation to the colouring matter of the cell-wall in tropical red dye-woods. With respect to the red autumnal coloration of leaves, the author states the colouring matter to stand in no direct relation to Chlorophyll, since they may occur in the same or distinct cells, or the former in the cells of the epiderm in which Chlorophyll does not occur. In either case the red colour is dissolved in the watery cell-sap and is not granular. The relation of the red element to tannin is insisted upon: the red coloration of spring and autumn only occurring in plants containing it. Further observations are added on the colouring matter of petals and the red and blue of many baccate fruits, and the relation of these to tannin.

——— Ueber das Verhalten der Zellenmembran zu den Pigmenten. Ibid. p. 129.

——— Ueben der Sitz der China-Alkaloide, Ibid. p. 137.

Willkomm, M. et J. Lange. — Prodromus Florae Hispanicae. Vol. i. pars altera, pp. 193-316. (*Colchicaceae* to *Aristolochieae*). A Conspectus of the Families and Orders (the Orders of M. Willkomm corresponding to Alliances, the Families to Nat. Orders as generally accepted) of the Spanish Flora is prefixed to the part.

No new genera are described. The Monocotyledons of Spain are computed at 840 species, referred to 200 genera, the eight largest Orders being Gramineae, Cyperaceae, Liliaceae, Orchideae, Amaryllideae, Juncaceae, Irideae, Smilaceae. The six largest of Apetalae are Chenopodiaceae, Polygoneae, Salicineae, Cupuliferae, Daphnoideae, Amarantaceae.

Wimmer, Fr.—Das Pflanzenreich. Anleitung z. Kenntniss desselben nach dem naturlichen System, unter Hinweisung auf das Linnê'sche System. Ed. 7, Breslau, 1862.

Zabel, H.—Ueber den fibrösen Bau der Zellwand. Two Plates. Mosc. Bull. 1861, v. 34, p. 384.

LXIII.—Cryptogamia.

Filicales.

Babington.—On British species of Isoetes. By C. C. Babington, M.A., F.R.S. Seemann's Journ. of Botany, Vol. I. Jan. 1863.

Bommer.—Note sur les poils des Fougères et sur les fonctions de ces Organes, par M. J. E. Bommer. Extract from the "Bulletins de la Société royal de botanique de Belgique.

Bosch.—Nouvelles especes d'Hymenophyllacées, par R. B. Van der Bosch. Journal de Botanique Neerlandaise. Vol. I. p. 344.

Braun.—Zwei deutsche Isoëtes Arten nebst Winken zur Aufsuchung derselben,und ein Anhang über einige ausländische Arten derselben Gattung, von Dr. A. Braun, Prof. d. Bot. zu Berlin—Besonders abgedruckt aus den Verhandlungen d. bot. Vereins für d. Provinz Brandenburg u. d. angrenzenden Länder, Heft. iii. iv. Berlin. Hermann Müller, 1862.

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Miscellanea.

ON A BOAT BELONGING PROBABLY TO THE THIRD CENTURY, AND FOUND IN A PEAT MOSS, NEAR FLENSBURG IN SLESVIG.

M. ENGELHARDT, Director of the Museum at Flensburg, and already so well known to Archæologists from his interesting descriptions of Antiquities found in the peat-mosses at Thorsbjerg and Nydam, has lately found at the latter place, close to the spot where the other discoveries had been made, a ship, or rather a large flat-bottomed boat, seventy feet in length, three feet deep in the middle and eight or nine feet wide. The sides are of oak-boards overlapping one another and fastened together by iron bolts. On the inner side of each board are several projections, which are not separate pieces of wood, but are continuous with the boards, and were therefore left when the latter were cut out of the solid timber. Each of these projections has two small holes, through which ropes, made of the inner bark of trees, were passed in order to fasten the sides of the boat to the ribs. The rowlocks are formed by a projecting horn of wood, under which is an orifice, so that a rope fastened to the horn and passing through the orifice, leaves a hole through which the oar plays. There appear to have been about fifty pairs of oars, of which sixteen have already been discovered. The bottom of the boat was covered by matting.

I visited the spot about a week after the boat had been discovered, but was unable to see much of it, as it had been taken to pieces and the boards, &c. were covered over with straw and peat, that they might dry slowly. In this manner M. Engelhardt hopes that they will perhaps, at least in part, retain their original shape.

The freight of the boat consisted of iron axes, including a socketed celt with its handle, swords, lances, knives, brooches, whetstones, wooden vessels, with, oddly enough, two birch brooms, and many smaller articles. Only those however have yet been found which remained actually in the boat, and as in sinking it turned partly over on its side, no doubt many more articles will reward the farther explorations which M. Engelhardt proposes to make next summer. It is evident that this interesting boat was sunk on purpose, because there is a square hole about six inches in diameter, hewn out of the bottom, and it is probable, that in some time of panic or danger the objects contained in it were hidden by their owner, who was never able to recover them.

Even in recent times of disturbance, as for instance in the beginning of this century and in 1848, many arms, ornaments, household utensils, &c. were so effectually hidden in the lakes and peat-mosses, that they could never be found again.

Much interest is added to this vessel and its contents by the fact that we can fix almost their exact date. The boat lies, as I have already mentioned, within a few yards of the spot where the previous discoveries at Nydam were made, and as all the arms and ornaments exactly correspond, there can be little doubt that they belong to the same period. Now the previous collection included nearly 50 Roman coins ranging in date from A. D. 67 to 217. Those found at Thorsberg in the same locality, and which are about as numerous, began with Nero and went down to the year 197.

Under these circumstances we may ascribe this vessel and its contents to the third century, without fear of any great inaccuracy.

Finally it may be mentioned that there are indications of a second boat lying close to the first. M. Engelhardt proposes to continue his researches next year, and we doubt not that he will discover many more objects of great interest.

J. L.

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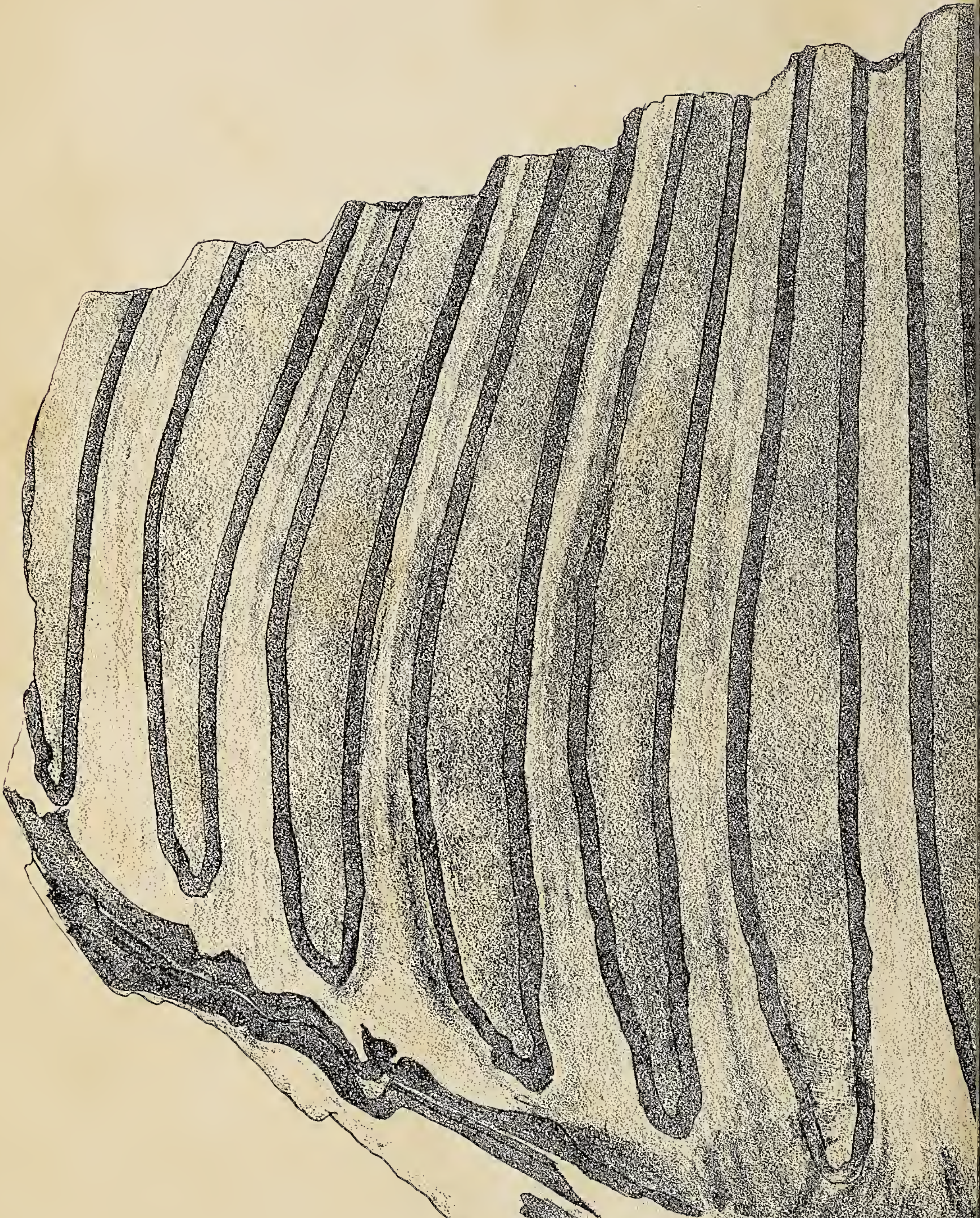

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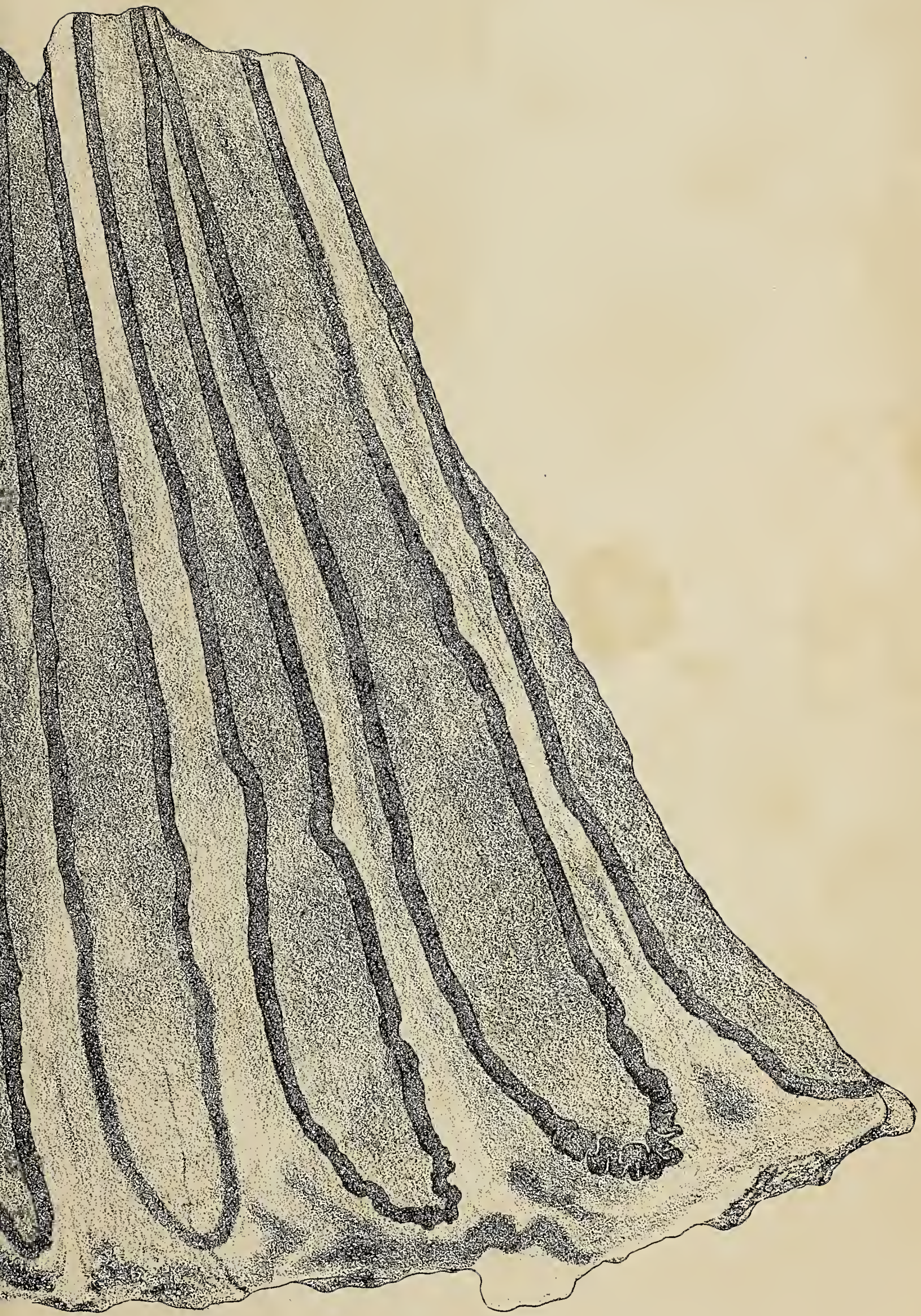

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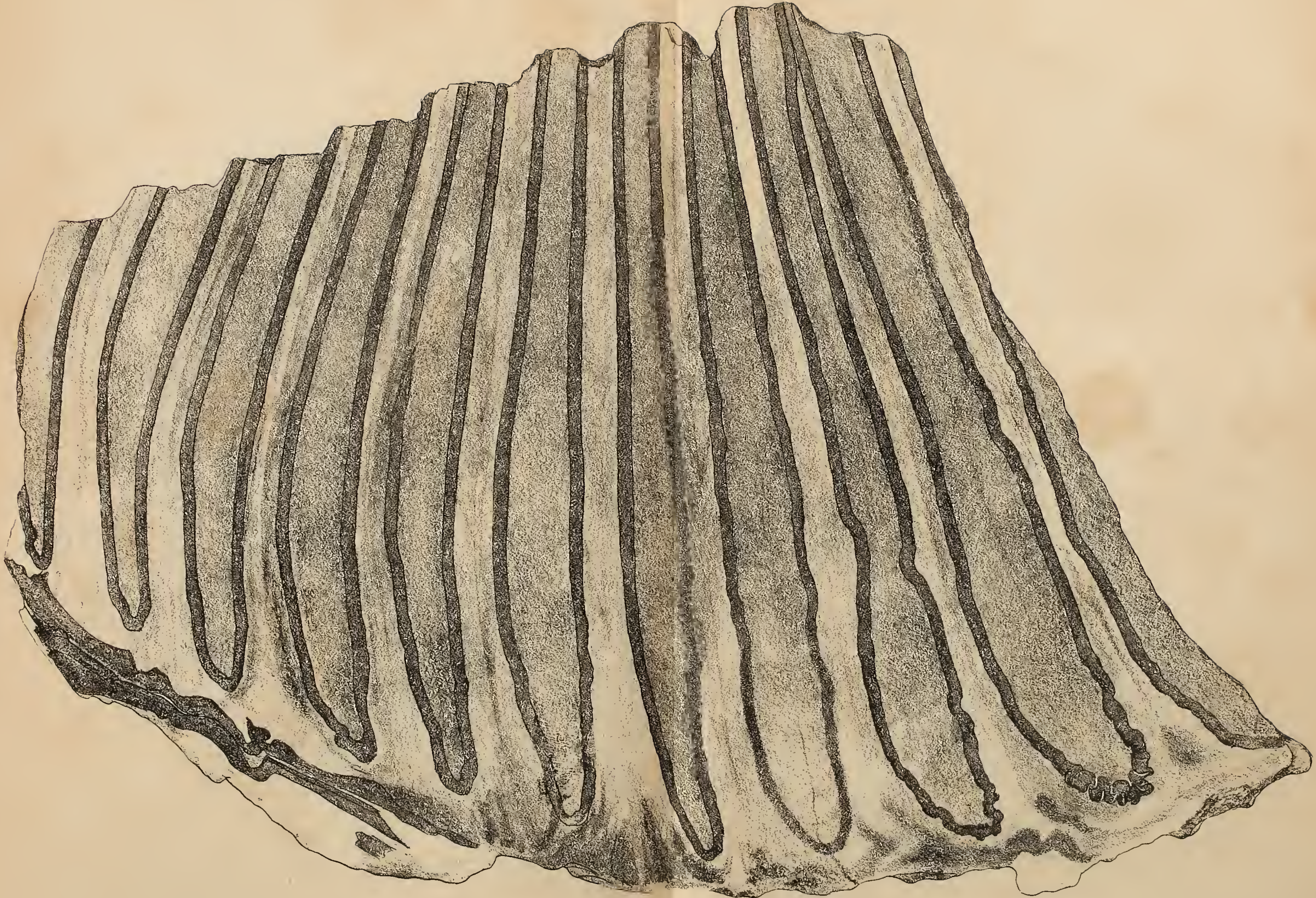

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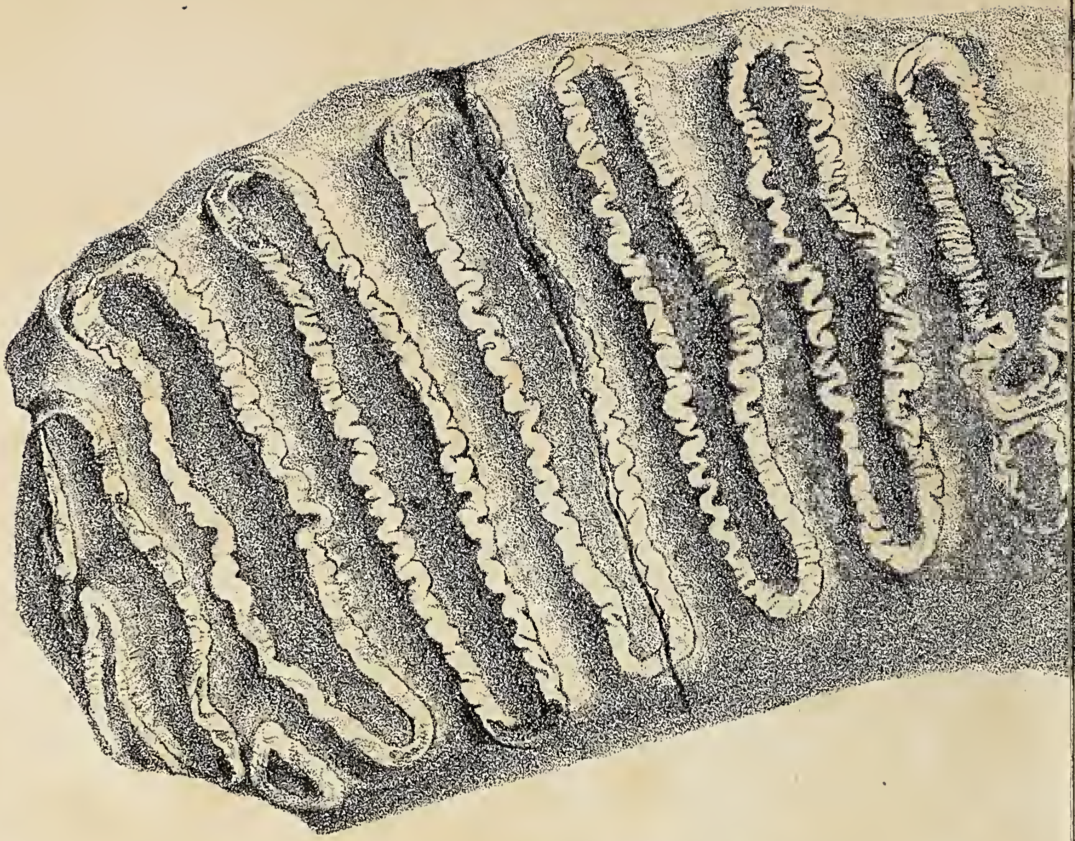

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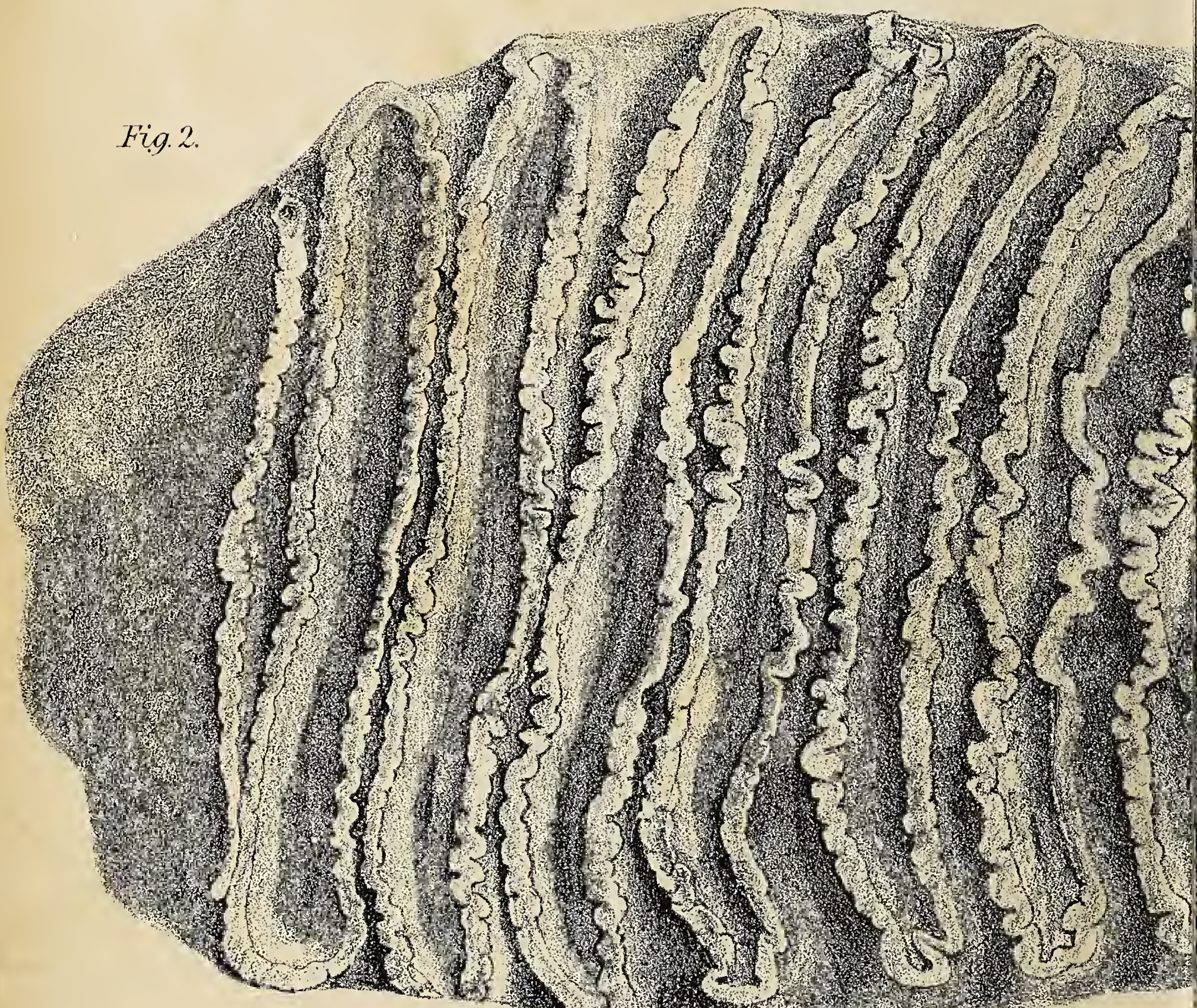

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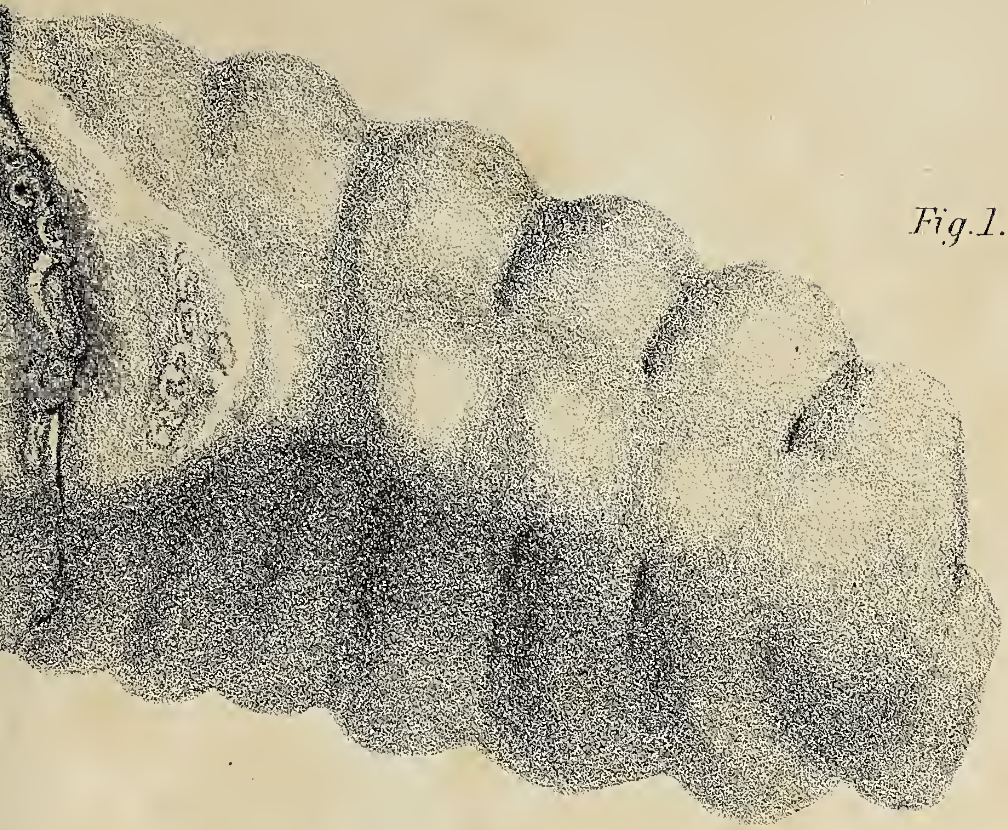

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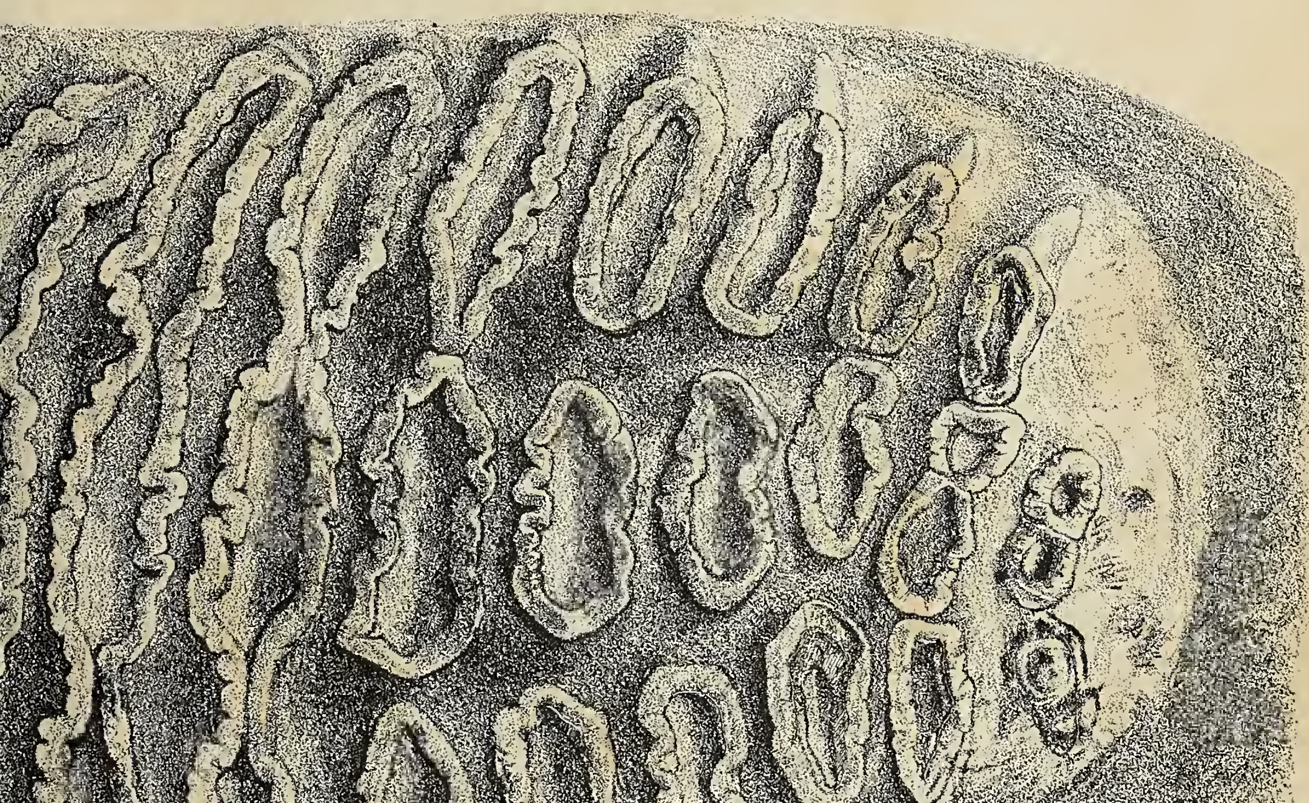

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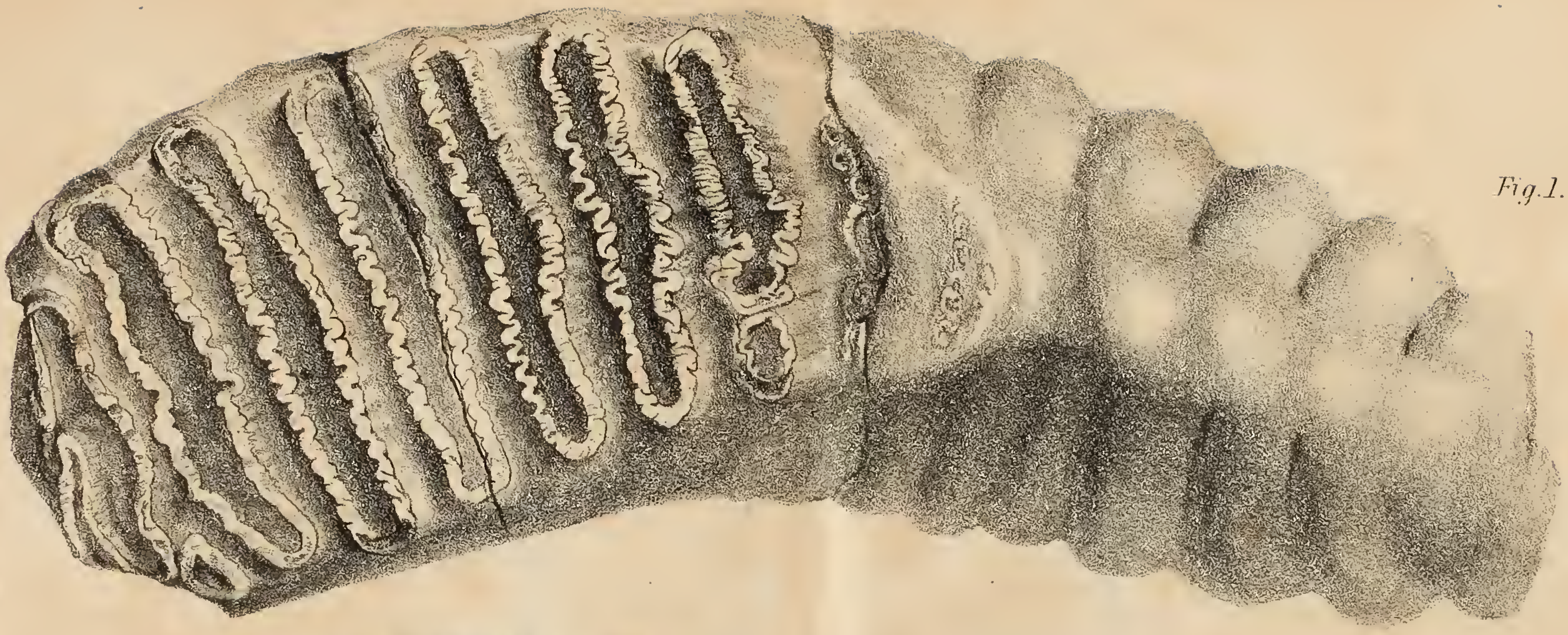

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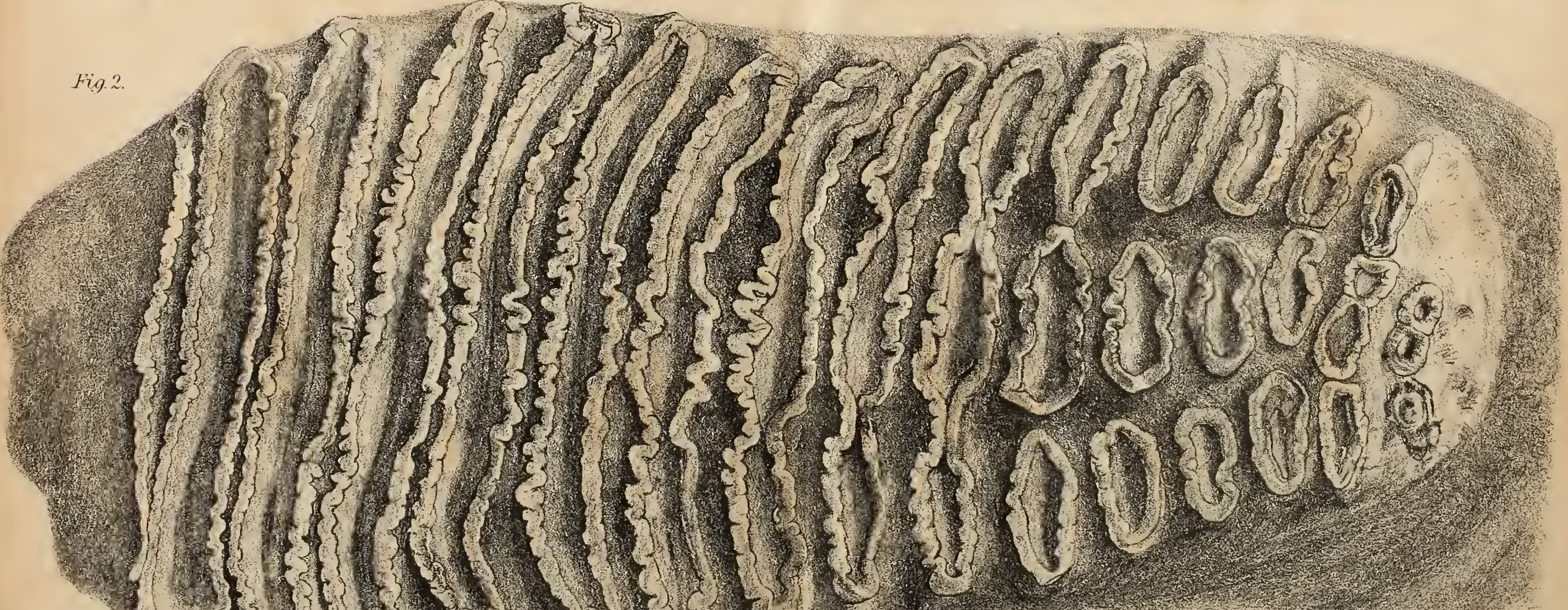

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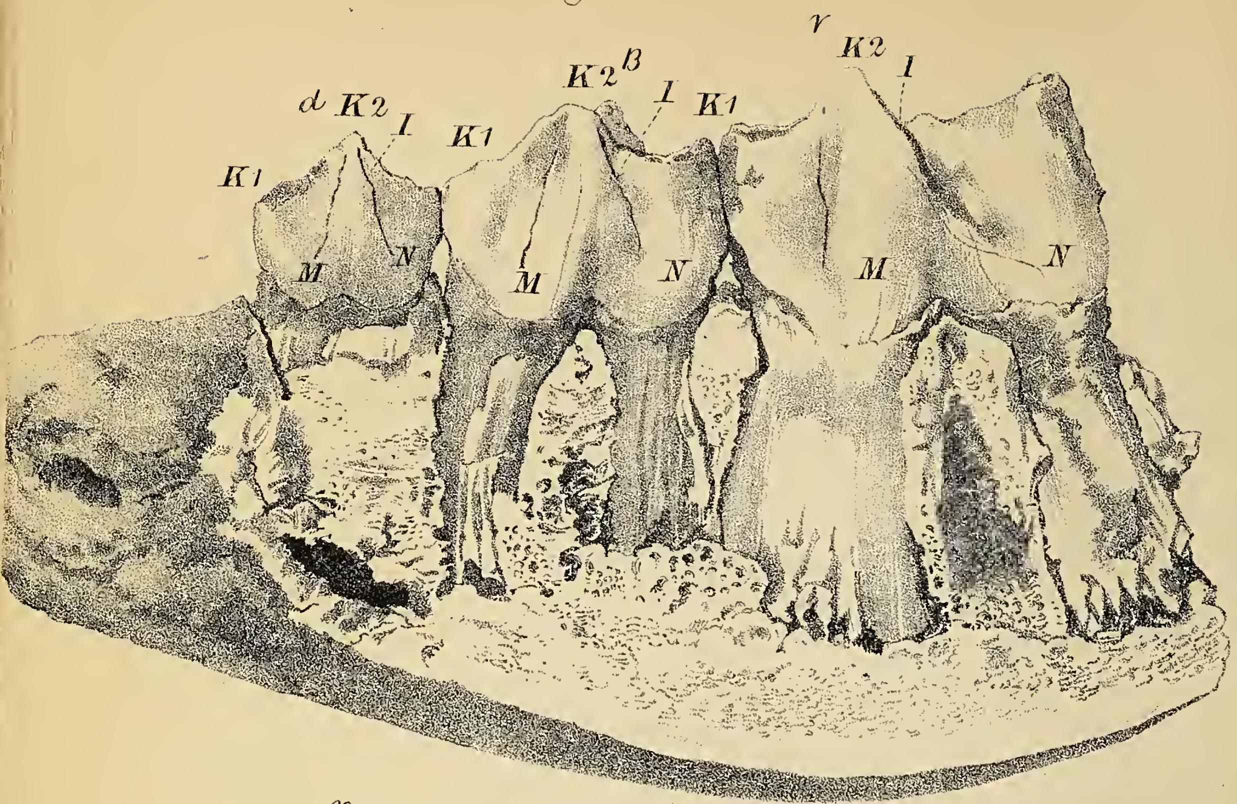
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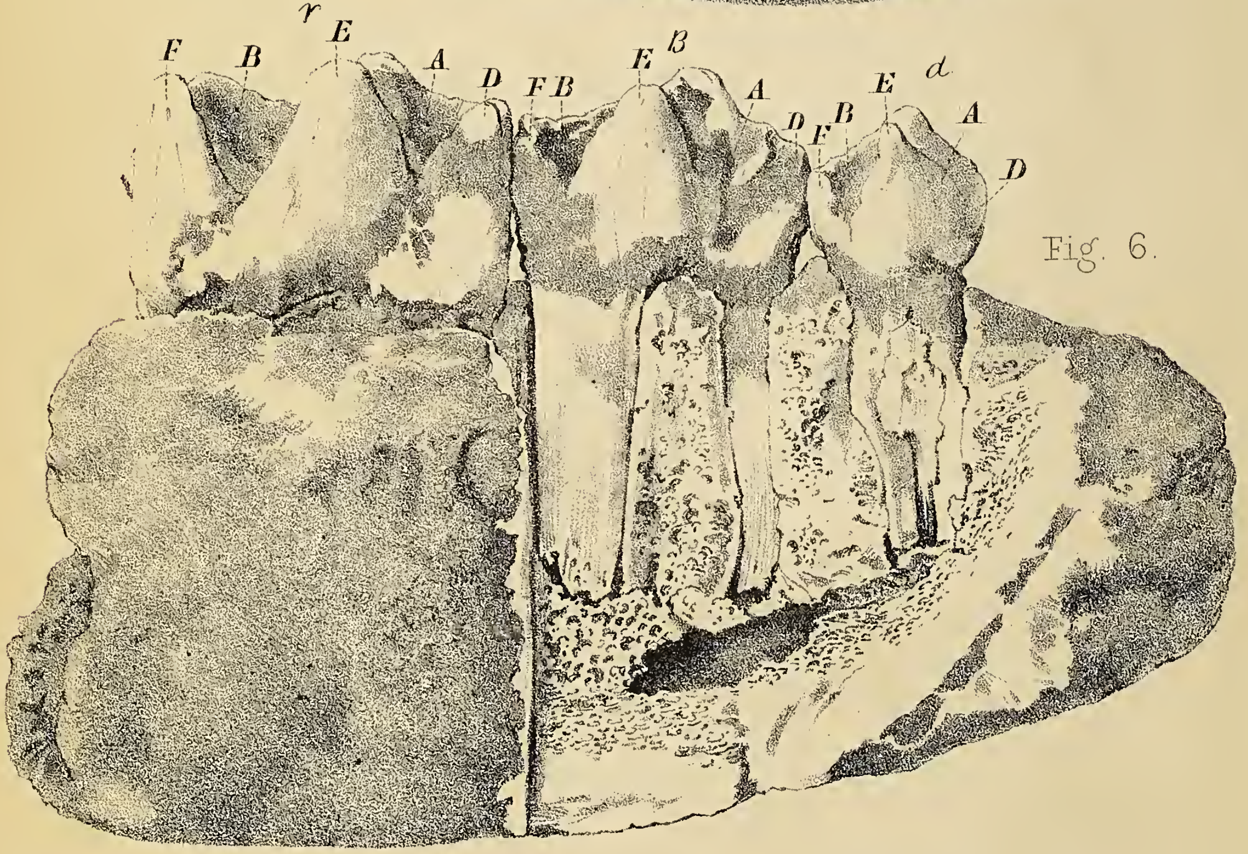
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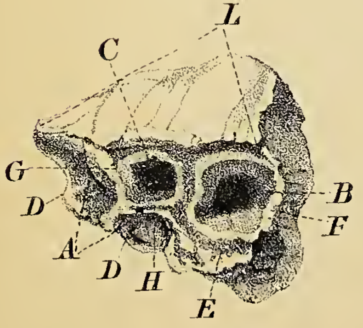
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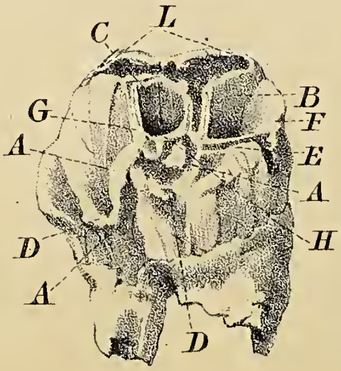
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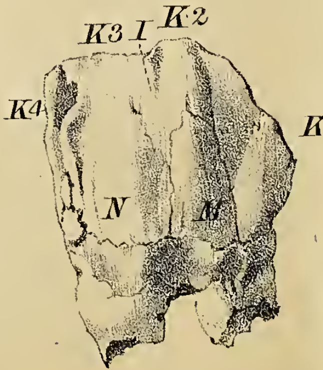
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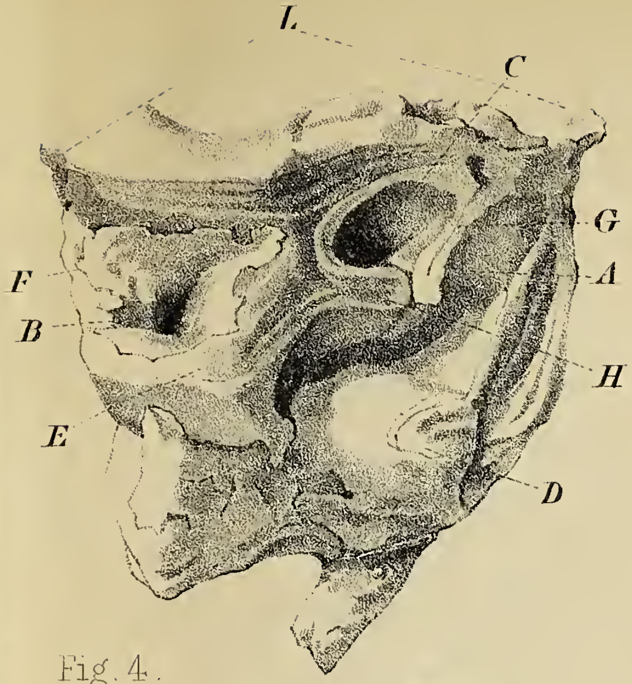

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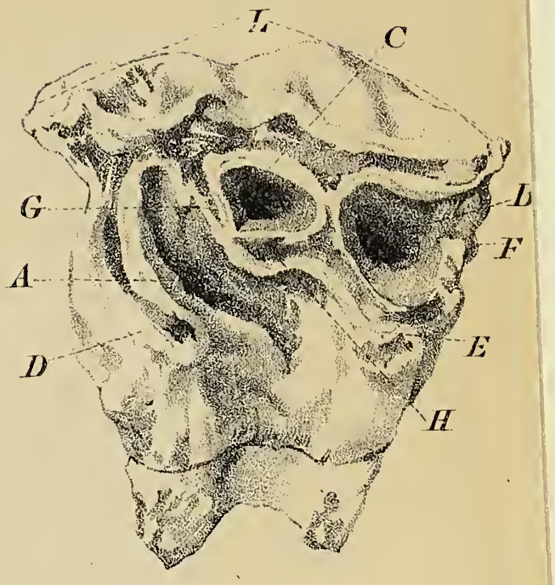

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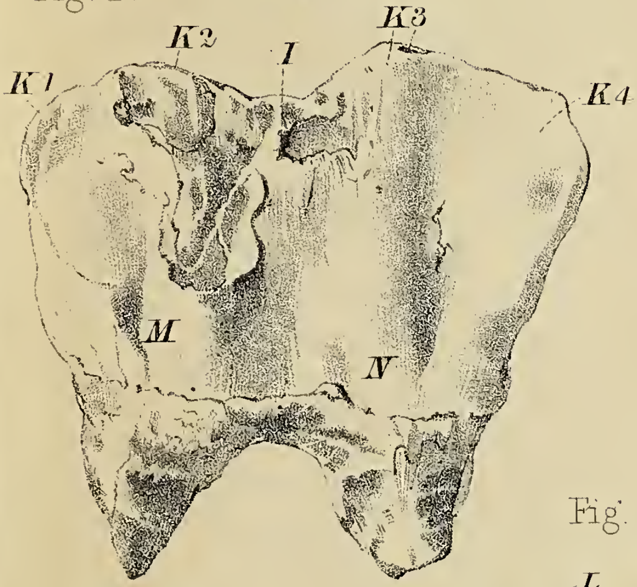
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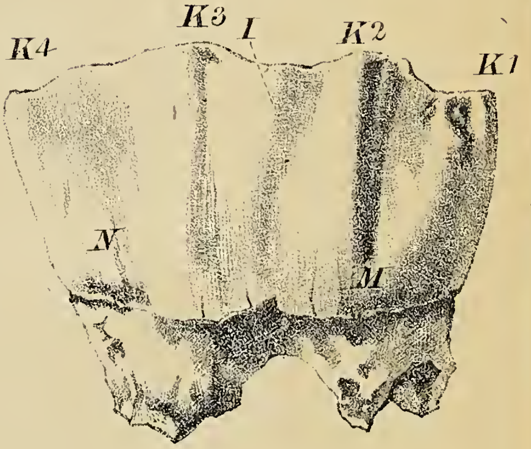
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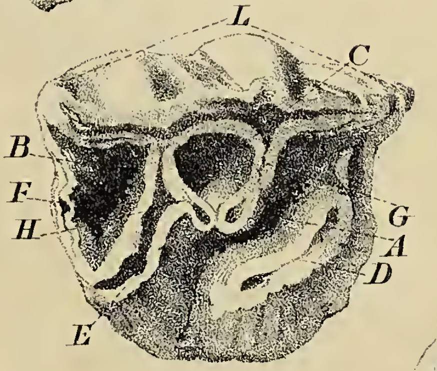

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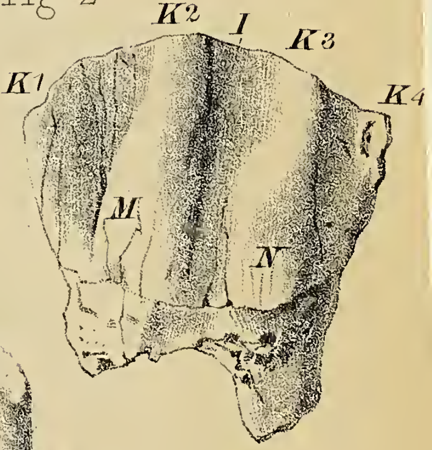
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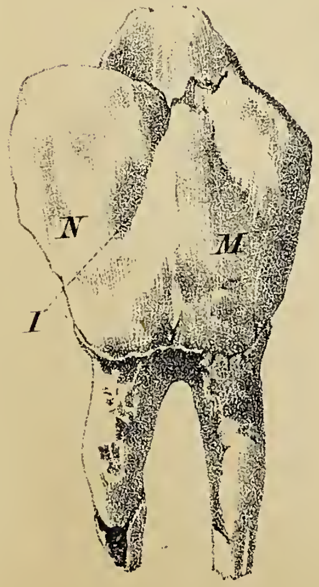
Fig. 7.



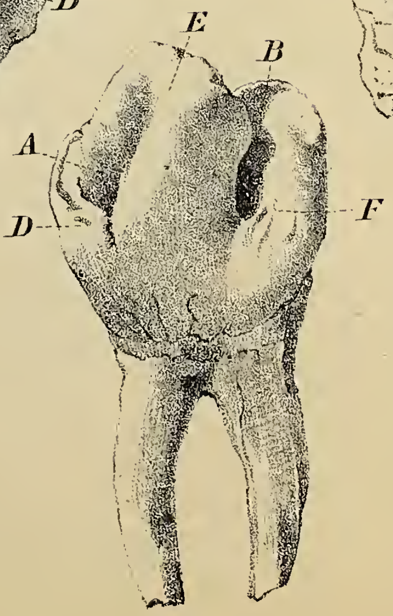


Fig. 7.

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